No. 200300259

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Michigan State University

Whereas, THERE HAS BEEN PRESENTED TO THE

Secretary of Agriculture

AN APPLICATION REQUESTING A CERTIFICATE OF PROTECTION FOR AN ALLEGED DISTINCT VARIETY OF SEXUALLY REPRODUCED, OR TUBER PROPAGATED PLANT, THE NAME AND DESCRIPTION OF WHICH ARE CONTAINED IN THE APPLICATION AND EXHIBITS, A COPY OF WHICH IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PLANT VARIETY PROTECTION OFFICE, IN THE APPLICANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID APPLICANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A CERTIFICATE OF PLANT VARIETY PROTECTION UNDER THE LAW.

NOW, THEREFORE, THIS CERTIFICATE OF PLANT VARIETY PROTECTION IS TO GRANT UNTO THE SAID APPLICANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID APPLICANT(S) FOR THE TERM OF TWENTY YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF THE REQUIRED FEES AND PERIODIC REPLENISHMENT OF VIABLE BASIC SEED OF THE VARIETY IN A PUBLIC REPOSITORY AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM SELLING THE VARIETY, OR OFFERING IT FOR SALE, OR REPRODUCING IT, OR IMPORTING IT, OR EXPORTING IT, CONDITIONING IT FOR PROPAGATION, OR STOCKING IT FOR ANY OF THE ABOVE PURPOSE , OR CONDITIONING IT PROPAGATION, OR STOCKING IT FOR ANY OF THE ABOVE PURPOSE, OR USING IT IN PRODUCING A HYBRID OR T VARIETY THEREFROM, TO THE EXTENT PROVIDED BY THE PLANT VARIETY PROTECTION ACT. IN STATES SEED OF THIS VARIETY (1) SHALL BE SOLD BY VARIETY NAME ONLY AS A CLASS OF CERTIFIED SE HALL CONFORM TO THE NUMBER OF GENERATIONS SPECIFIED BY THE OWNER OF THE RIGHTS. (84 STAT. 1542, A D, 7 U.S.C. 2321 ET SEQ.)

WHEAT, COMMON

'MSU D6234'

In Testimony Whereof, I have hereunto set my hand and caused the seal of the Plant Variety Protection Office to be affixed at the City of Washington, D.C. this seventh day of May, in the year two thousand and four.

Attest:

Commissioner
Plant Variety Protection Office
Agricultural Marketing Service

of Agriculture

REPRODUCE LOCALLY. *Include form number and date on all reproductions*

Form Approved - OMB No. 0581-0055

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
SCIENCE AND TECHNOLOGY - PLANT VARIETY PROTECTION OFFICE

APPLICATION FOR PLANT VARIETY PROTECTION CERTIFICATE
(Instructions and information collection burden statement on reverse)

The following statements are made in accordance with the Privacy Act of 1974 (5 U.S.C. 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF OWNER
Michigan State University

2. TEMPORARY DESIGNATION OR EXPERIMENTAL NAME
D6234

3. VARIETY NAME
MSU D6234

4. ADDRESS *(Street and No., or R.F.D. No., City, State, and ZIP Code, and Country)*
246 Administration Building
East Lansing, MI 48824-1046

5. TELEPHONE *(include area code)*

6. FAX *(include area code)*

FOR OFFICIAL USE ONLY

PVPO NUMBER
2003 00 259

FILING DATE
MAY 22, 2003

7. IF THE OWNER NAMED IS NOT A "PERSON", GIVE FORM OF ORGANIZATION *(corporation, partnership, association, etc.)*
Land Grant University

8. IF INCORPORATED, GIVE STATE OF INCORPORATION
N/A

9. DATE OF INCORPORATION
N/A

10. NAME AND ADDRESS OF OWNER REPRESENTATIVE(S) TO SERVE IN THIS APPLICATION. *(First person listed will receive all papers)*
Dr. Michael Lang, Esquire or
Ms. Loraine J. Hudson
Office of Intellectual Property
Michigan State University
246 Administration Building
East Lansing, MI 48824-1046

FEES RECEIVED

FILING AND EXAMINATION FEES:
$ 3220.00
DATE 5/22/2003

CERTIFICATION FEE:
$ 432.00
7/15/2003
~~DATE~~ $432.00
DATE 03/22/2004

11. TELEPHONE *(Include area code)*
517-355-2186

12. FAX *(Include area code)*
517-432-3880

13. E-MAIL
oip@msu.edu

14. CROP KIND *(Common Name)*
common wheat

15. GENUS AND SPECIES NAME OF CROP
Triticum aestivum

16. FAMILY NAME *(Botanical)*
Graminaee

17. IS THE VARIETY A FIRST GENERATION HYBRID?
☐ YES ☒ NO

18. CHECK APPROPRIATE BOX FOR EACH ATTACHMENT SUBMITTED (Follow instructions on reverse)

a. ☒ Exhibit A. Origin and Breeding History of the Variety
b. ☒ Exhibit B. Statement of Distinctness
c. ☒ Exhibit C. Objective Description of Variety
d. ☒ Exhibit D. Additional Description of the Variety *(Optional)* MAH 5/23/02
e. ☒ Exhibit E. Statement of the Basis of the Owner's Ownership
f. ☒ Voucher Sample *(2,500 viable untreated seeds or, for tuber propagated varieties, verification that tissue culture will be deposited and maintained in an approved public repository)*
g. ☒ Filing and Examination Fee ($3,652), made payable to "Treasurer of the United States" *(Mail to the Plant Variety Protection Office)*

19. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE SOLD AS A CLASS OF CERTIFIED SEED? *See Section 83(a) of the Plant Variety Protection Act)*
☒ YES *(If "yes", answer items 20 and 21 below)* ☐ NO *(If "no", go to item 22)*

20. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE LIMITED AS TO NUMBER OF CLASSES? ☒ YES ☐ NO
IF YES, WHICH CLASSES? ☒ FOUNDATION ☐ REGISTERED ☒ CERTIFIED

21. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE LIMITED AS TO NUMBER OF GENERATIONS? ☐ YES ☒ NO
IF YES, SPECIFY THE NUMBER 1,2,3, etc. FOR EACH CLASS.
☐ FOUNDATION ☐ REGISTERED ☐ CERTIFIED
(If additional explanation is necessary, please use the space indicated on the reverse.)

22. HAS THE VARIETY (INCLUDING ANY HARVESTED MATERIAL) OR A HYBRID PRODUCED FROM THIS VARIETY BEEN SOLD, DISPOSED OF, TRANSFERRED, OR USED IN THE U. S. OR OTHER COUNTRIES?
☐ YES ☒ NO
IF YES, YOU MUST PROVIDE THE DATE OF FIRST SALE, DISPOSITION, TRANSFER, OR USE FOR EACH COUNTRY AND THE CIRCUMSTANCES. *(Please use space indicated on reverse.)*

23. IS THE VARIETY OR ANY COMPONENT OF THE VARIETY PROTECTED BY INTELLECTUAL PROPERTY RIGHT *(PLANT BREEDER'S RIGHT OR PATENT)*?
☐ YES ☒ NO
IF YES, PLEASE GIVE COUNTRY, DATE OF FILING OR ISSUANCE AND ASSIGNED REFERENCE NUMBER. *(Please use space indicated on reverse.)*

24. The owners declare that a viable sample of basic seed of the variety has been furnished with application and will be replenished upon request in accordance with such regulations as may be applicable, or for a tuber propagated variety a tissue culture will be deposited in a public repository and maintained for the duration of the certificate.

The undersigned owner(s) is(are) the owner of this sexually reproduced or tuber propagated plant variety, and believe(s) that the variety is new, distinct, uniform, and stable as required in Section 42, and is entitled to protection under the provisions of Section 42 of the Plant Variety Protection Act.

Owner(s) is(are) informed that false representation herein can jeopardize protection and result in penalties.

SIGNATURE OF OWNER	SIGNATURE OF OWNER
Loraine J. Hudson	Michael J. Lang
NAME *(Please print or type)*	NAME *(Please print or type)*
Loraine J. Hudson	Michael J. Lang
CAPACITY OR TITLE	CAPACITY OR TITLE
Director	Licensing Associate
DATE	DATE
5/15/03	5/15/03

INSTRUCTIONS

2003 00 259

GENERAL: To be effectively filed with the Plant Variety Protection Office (PVPO), **ALL** of the following items must be **received** in the PVPO: (1) Completed application form signed by the owner; (2) completed exhibits A, B, C, E; (3) for a seed reproduced variety at least 2,500 viable untreated seeds, for a hybrid variety at least 2,500 untreated seeds of each line necessary to **reproduce** the variety, or for tuber reproduced varieties verification that a viable *(in the sense that it will reproduce an entire plant)* tissue culture will be deposited and maintained in an approved public repository; (4) check drawn on a U.S. bank for $3,652 ($432 filing fee and $3,220 examination fee), payable to "Treasurer of the United States" *(See Section 97.6 of the Regulations and Rules of Practice.)* Partial applications will be held in the PVPO for not more than 90 days, then returned to the applicant as unfiled. Mail application and other requirements to Plant Variety Protection Office, AMS, USDA, Room 401, NAL Building, 10301 Baltimore Avenue, Beltsville, MD 20705-2351. Retain one copy for your files. All items on the face of the application are self explanatory unless noted below. Corrections on the application form and exhibits must be initialed and dated. **DO NOT** use masking materials to make corrections. If a certificate is allowed, you will be requested to send a check payable to "Treasurer of the United States" in the amount of $432 for issuance of the certificate. Certificates will be issued to owner, not licensee or agent.

Plant Variety Protection Office
Telephone: (301) 504-5518
FAX: (301) 504-5291
Homepage: http://www.ams.usda.gov/science/pvpo/pvp.htm

ITEM

18a. Give:
(1) the genealogy, including public and commercial varieties, lines, or clones used, and the breeding method;
(2) the details of subsequent stages of selection and multiplication;
(3) evidence of uniformity and stability; and
(4) the type and frequency of variants during reproduction and multiplication and state how these variants may be identified

18b. Give a summary of the variety's distinctness. Clearly state how this application variety may be distinguished from all other varieties in the same crop. If the new variety is most similar to one variety or a group of related varieties:

(1) identify these varieties and state all differences objectively;
(2) attach statistical data for characters expressed numerically and demonstrate that these are clear differences; and
(3) submit, if helpful, seed and plant specimens or photographs (prints) of seed and plant comparisons which clearly indicate distinctness.

18c. Exhibit C forms are available from the PVPO Office for most crops; specify crop kind. Fill in Exhibit C (Objective Description of Variety) form as completely as possible to describe your variety.

18d. Optional additional characteristics and/or photographs. Describe any additional characteristics that cannot be accurately conveyed in Exhibit C. Use comparative varieties as is necessary to reveal more accurately the characteristics that are difficult to describe, such as plant habit, plant color, disease resistance, *etc.*

18e. Section 52(5) of the Act requires applicants to furnish a statement of the basis of the applicant's ownership. An Exhibit E form is available from the PVPO.

19. If "Yes" is specified *(seed of this variety be sold by variety name only, as a class of certified seed)*, the applicant **MAY NOT** reverse this affirmative decision after the variety has been sold and so labeled, the decision published, or the certificate issued. However, if "No" has been specified, the applicant may change the choice. *(See Regulations and Rules of Practice, Section 97.103).*

22. *See Sections 41, 42, and 43 of the Act and Section 97.5 of the regulations for eligibility requirements.*

23. *See Section 55 of the Act for instructions on claiming the benefit of an earlier filing date.*

21. CONTINUED FROM FRONT *(Please provide a statement as to the limitation and sequence of generations that may be certified.)*

The limit on seed classes allows foundation and certified classes only. No limit on generations. Sequence of generations is foundation then certified.

22. CONTINUED FROM FRONT *(Please provide the date of first sale, disposition, transfer, or use for each country and the circumstances, if the variety (including any harvested material) or a hybrid produced from this variety has been sold, disposed of, transferred, or used in the U.S. or other countries.)*

Not applicable.

23. CONTINUED FROM FRONT *(Please give the country, date of filing or issuance, and assigned reference number, if the variety or any component of the variety is protected by intellectual property right (Plant Breeder's Right or Patent).)*

Not applicable.

NOTES: It is the responsibility of the applicant/owner to keep the PVPO informed of any changes of address or change of ownership or assignment or owner's representative during the life of the application/certificate. There is no charge for filing a change of address. The fee for filing a change of ownership or assignment or any modification of owner's name is specified in Section 97.175 of the regulations. *(See Section 101 of the Act, and Sections 97.130, 97.131, 97.175(h) of the Regulations and Rules of Practice.)*

To avoid conflict with other variety names in use, the applicant must check the appropriate recognized authority. For example, for agricultural and vegetable crops, contact: Seed Branch, AMS, USDA, Room 213, Building 306, Beltsville Agricultural Research Center--East, Beltsville, MD 20705. Telephone: (301) 504-8089. http://www.ams.usda.gov/lsg/seed.htm

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0581-0055. The time required to complete this information collection is estimated to average 3.0 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, sexual orientation, marital or family status, political beliefs, parental status, or protected genetic information. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

ST-470 (02-10-2003) designed by the Plant Variety Protection Office with Word 2000. Replaces former versions of ST-470, which are obsolete.

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Exhibit A: Origin and Breeding History of 'MSU D6234'

[revised 2/26/04]

'MSU D6234' is derived from a cross between Michigan State University (MSU) breeding lines X1291 ('F12.71', PI 376484/2*'Frankenmuth') and C5107 ('Norin 10' / 'Brevor' / /'Yorkwin '/3/ 2*'Genesee' /4/ Genesee*3 / 'Redcoat' /5/ 'Suweon 92' / Brevor // 5*Genesee /4/ Norin10 / Brevor // Yorkwin /3/ 3*Genesee /6/ 'Talbot' / CItr 8487 /3/ Genesee*4 // Norin 10 / Brevor). That cross was made in 1990 at MSU and was designated population 900522. During its development, MSU D6234 was identified as experimental line D6234.

MSU D6234 has been observed for two generations of large scale increase and is stable and uniform. Variants appear in MSU D6234 at commercially acceptable and predictable frequencies. Variants include red seed (fewer than 1 in 200), awned spikes (fewer than 1 in 100) and bronze chaff (fewer than 1 in 100). Both of the direct parents (C5107 and X1291) were eliminated from the breeding program before MSU D6234 was derived, tested, and multiplied. Data from direct comparisons between MSU D6234 and its parents therefore does not exist.

The details of the subsequent stages of selection and multiplication are portrayed graphically in Figure 1 on page four of this exhibit. A narrative of that process follows. The F2 and F3 generations were field-grown at commercial planting densities (370 to 495 seeds/m^2) with moderate bulk selection for plant height in the F3 generation. The F4 generation was also grown in the field in Michigan as a population bulk. Individual spikes (i.e., heads) were harvested from the F4 generation and planted as F4:5 head rows. Visually superior F4:5 head row families were individually bulk harvested and planted in 1995 as F4:6 families. Selection criteria included seed coat color (white), seed quality, reduced plant height, and adult plant resistance to lodging, powdery mildew (*Blumeria graminis f. sp. tritici*), wheat spindle streak mosaic virus, leaf blotches (*Stagonospora nodorum and/or Septoria tritici)*, and seed quality. One F4:6 family from population 900522 was selected to be advanced into the yield testing program with the designation D6234.

The F4:7 seed of D6234 was used for multi-location preliminary yield testing in the 1996/97 season. Selection of D6234 for further testing and seed multiplication was based on yield of grain per unit area of land, test weight, plant height, resistance to lodging, and general plant health. Seed purification and multiplication was initiated by selecting 10 F7:8 heads from one plot of D6234 in the 96/97 preliminary yield trial. Those 10 heads were checked individually for seed color and then hand planted as a bulk (F4:8) to initiate a pure seed source.

Three types of plantings were made of D6234 in the 97/98 season: advanced multi-location yield trials, Level 1 (L1) drill strip increase, and a hand planted pure seed lot. Yield test seed from one site of the 96/97 preliminary yield test of D6234 was used as the seed source for both the L1 increase and the advanced yield trial. Seed for the hand planted pure seed lot was the bulk of the 10 selected F7:8 heads described above.

Two types of plantings were made of D6234 in the 98/99 season: MSU state variety and other yield trials, and a Level 1 purity (L1p) drill strip increase. Seed for the yield trials came from the L1 drill strip harvested in 1998. The seed used to plant the L1p drill strip originated from hand harvest of the hand planted bulk of 10 F7:8 heads described above.

The 98/99 L1p drill strip was harvested in three ways. First, 300 heads were selected for further purification. Second, a small section of the drill strip was hand harvested as a source of a second L1p drill strip for the 99/00 season. Finally, the remainder of the 98/99 L1p drill strip was machine harvested to provide seed for the 99/00 yield trials.

Yield test seed for the 2000 and 2001 harvest seasons was derived from hand harvested descendents the L1p drill strip planted in the 98/99 season. Yield test seed for the 2002 harvest came from the pre-Breeder seed lot described below.

Pre-Breeder seed of D6234 originated from the 300 heads selected from the 98/99 L1p drill strip. Those heads were individually threshed, confirmed to have white seed, and planted as distinct head-rows in the 99/00 seasons. Approximately 250 of the F9:10 head rows were selected and harvested by hand

in 2000 to create a like number of F9:11 families, all direct descendents of the 10 F8 heads harvested in 1998, which in turn are all direct descendents of the single F4 head in 1994. After confirmation of grain color, the 250 F9:10 families were space-planted for the 00/01 season with a precision pneumatic planter in a locale that presented at least 1000 meters physical isolation from any other source of wheat pollen.

Approximately 90 F9:11 families were selected for harvest in 2001. The most obvious off-type (variant) in this generation was bronze chaff color, which presumably arose from out-crossing in the F9 generation. Families with any bronze chaff were discarded. The 90 selected F9:11 families were harvested into a single bulk of approximately 27 kilograms of F4:12 generation pre-Breeder seed using a combine specially cleaned to eliminate mechanical contamination. No red kernels were found in a NaOH stained sample of 3500 seeds of the pre-Breeder seed bulk.

This application proposes that the experimental line D6234 be named 'MSU D6234'. The pre-Breeder and subsequent generations of MSU D6234 consequently represent an F4-derived line, with single plant progeny selection for uniformity of type occurring in the F7, F9, and F11 generations. A total of 575 bushels of first generation Breeder seed was produced from the pre-Breeder seed by the Michigan Crop Improvement Association in the 2001/2 season. Approximately 25kg of the pre-Breeder seed is retained in storage. Subsequent Breeder seed will be derived by upgrading regions of Foundation seed fields to the status of Breeder seed. .

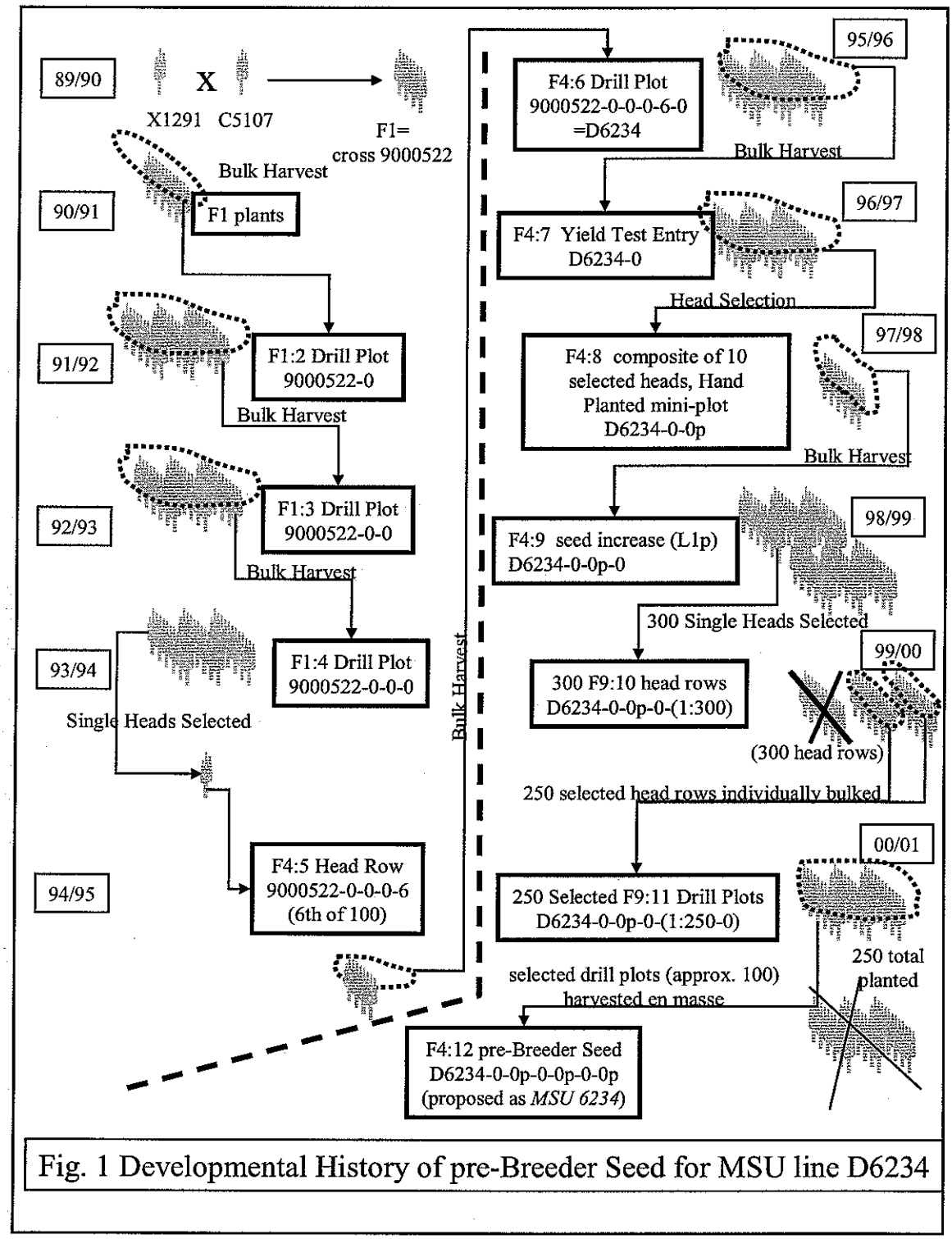

Fig. 1 Developmental History of pre-Breeder Seed for MSU line D6234

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Exhibit B: Statement of Distinctness for 'MSU D6234'

[revised 2/26/04]

'MSU D6234' is most similar to 'Lowell'; however MSU 6234 exhibits higher test weight than Lowell, and is shorter than Lowell. Single site statistics for field experiments which included both MSU D6234 and Lowell are presented in Table 1 (test weight) and Table 2 (plant height). Each row in those tables contains the means, maximums, and minimums for Lowell and MSU D6234 at a single location in a single year. The relevant Least Significant Differences (LSD), generated by analysis of variance with the SAS Institute's GLM procedure, is also included in each row. Additional varieties and experimental lines were included in the field experiments, but only data for the Lowell and MSU D6234 were employed in the analyses. The LSD values for Test Weight and Plant Height were determined with alpha (Type I error) set at 0.05 and 0.075, respectively. Tests for Normality were conducted with the SAS Institute's Univariate procedure incorporating the 'Normal' option. Shapiro-Wilk 'W' values were not significant (alpha=0.05) for any of the year/site/variety data subsets.

Procedural details of each experiment represented in Tables 1 and 2 are presented in Table 3. Test weight was determined as plots were harvested with an on-board electronic load cell and moisture meter system. Plant height (height of the terminal spikelet in erect plants) was determined on individual plots by repeated observations within a plot followed by identification and measurement of a stem representative of that plot.

TABLE 1. TEST WEIGHT (KILOGRAMS per HECTOLITER): Single site test weight data comparing MSU D6234 and Lowell at two sites in 2001 and four sites in 2002. The average test weights are from four replications from each site.

					MAXIMUM AND MINIMUM VALUES BY VARIETY			
		MSU D6234	LOWELL		MSU D6234		LOWELL	
HARVEST YEAR	COUNTY SITE NAME	AVERAGE TEST WEIGHT	AVERAGE TEST WEIGHT	LSD alpha = 0.05	MAXIMUM TEST WEIGHT	MINIMUM TEST WEIGHT	MAXIMUM TEST WEIGHT	MINIMUM TEST WEIGHT
2001	LENAWEE	75.1	73.1	1.0	75.4	74.8	74.0	72.6
2001	SANILAC	79.0	75.6	0.7	79.4	78.8	76.1	75.1
2002	SANILAC	77.5	72.1	3.4	77.8	77.2	72.9	71.2
2002	SAGINAW	77.5	73.4	2.0	78.5	76.2	74.5	72.9
2002	MIDLAND	78.9	74.0	2.1	79.9	77.4	74.7	72.5

TABLE 2. PLANT HEIGHT (CENTIMETERS): Single site plant height data comparing MSU D6234 and Lowell at two sites in 2002. The average plant heights are from four replications from each site.

					MAXIMUM AND MINIMUM VALUES BY VARIETY			
		MSU D6234	LOWELL		MSU D6234		LOWELL	
HARVEST YEAR	COUNTY SITE NAME	AVERAGE PLANT HEIGHT	AVERAGE PLANT HEIGHT	LSD alpha = 0.075	MAXIMUM PLANT HEIGHT	MINIMUM PLANT HEIGHT	MAXIMUM PLANT HEIGHT	MINIMUM PLANT HEIGHT
2002	SAGINAW	108.7	115.6	6.5	114.3	104.1	119.4	111.8
2002	MIDLAND	101.6	109.2	3.4	104.1	99.1	111.8	106.7

TABLE 3. Procedural Details of Experiments Referenced in Tables 1 and 2.

HARVEST YEAR	COUNTY SITE NAME	CLOSEST INTERSECTION	PLOT SIZE (M2)	PLANTS PER PLOT	NUMBER OF REPLICATIONS		PLANTING DATE	HARVEST DATE	DATE OF OBSERVATIONS	
					TEST WEIGHT	PLANT HEIGHT			TEST WEIGHT	PLANT HEIGHT
2001	LENAWEE	Britton Hwy. & Holloway Rd	5.1	2273	4	-----	10/03/00	07/12/01	10/03/00	-----
2001	SANILAC	M-46 & Townline Rd.	5.1	2273	4	-----	10/01/00	07/20/01	10/01/00	-----
2002	SANILAC	M-19 & Miller Rd.	5.1	2273	4	-----	10/04/01	07/20/02	10/04/01	-----
2002	SAGINAW	M-46 & M-83	5.1	2273	4	4	10/08/01	07/16/02	10/08/01	06/20/02
2002	MIDLAND	S Homer Rd. & Laporte Rd.	5.1	2273	4	4	10/09/01	07/17/02	10/09/01	06/27/02

D

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Form Approved - OMB No. 0581-0055

instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
SCIENCE AND TECHNOLOGY
PLANT VARIETY PROTECTION OFFICE
BELTSVILLE, MD 20705

EXHIBIT C
(*Wheat*)

OBJECTIVE DESCRIPTION OF VARIETY
WHEAT (*Triticum* spp.)

NAME OF APPLICANT(S)

ADDRESS (*Street and No. or RD No., City, State, and Zip Code*)

FOR OFFICIAL USE ONLY

PVPO NUMBER 2003 00 259

VARIETY NAME ~~MSU 6234~~ MSU D6234 MH 3/5/04

TEMPORARY OR EXPERIMENTAL DESIGNATION D6234

PLEASE READ ALL INSTRUCTIONS CAREFULLY: Place the appropriate number that describes the varietal character of this variety in the boxes below. Place a zero in the first box (e.g. [0][9] or [0][9]) when number is either 99 or less or 9 or less respectively. Data for quantitative plant characters should be based on a minimum of 100 plants. Comparative data should be determined from varieties entered in the same trial. Royal Horticultural Society or any recognized color standard may be used to determine plant colors; designate system used: _____

Please answer all questions for your variety; lack of response may delay progress of your application.

1. KIND:

[1]
1=Common
2=Durum
3=Club
4=Other (SPECIFY) : _____

2. VERNALIZATION:

[2]
1=Spring
2=Winter
3=Other (SPECIFY) : _____

3. COLEOPTILE ANTHOCYANIN:

[1] 1 = Absent 2 = Present

4. JUVENILE PLANT GROWTH:

[2] 1 = Prostrate 2 = Semi-erect 3 = Erect

5. PLANT COLOR (boot stage):

[2]
1 = Yellow-Green
2 = Green
3 = Blue-Green

6. FLAG LEAF (boot stage):

[2] 1 = Erect
2 = Recurved

[1] 1 = Not Twisted
2 = Twisted

[1] 1 = Wax Absent
2 = Wax Present

7. EAR EMERGENCE: [days after January 1]

[1][5][6] Number of Days (Average)

[0][3] Number of Days Earlier Than Frankenmuth *

Same as Harus *

[0][1] Number of Days Later Than Hopewell *

* Relative to a PVPO-Approved Commercial Variety Grown in the Same Trial

2003 00 259

8. ANTHER COLOR:

[1] 1 = Yellow
2 = Purple

9. PLANT HEIGHT (from soil to top of head, excluding awns):

[1][0][4] cm (Average)

[0][6] cm Taller Than Caledonia *

Same as N/A *

[0][9] cm Shorter Than Harus *

10. STEM:

A. ANTHOCYANIN

[1] 1= Absent
2 = Present

B. WAXY BLOOM

[1] 1 = Absent
2 = Present

C. HAIRINESS
(last internode of rachis)

[1] 1 = Absent
2 = Present

D. INTERNODE

[1] 1 = Hollow 2 = Semi-solid 3 = Solid

[4] Number of Nodes

E. PEDUNCLE

[1] 1 = Erect 2 = Recurved 3 = Semi-erect

[3][5] cm Length

F. AURICLE

[1] Anthocyanin 1 = Absent 2 = Present

[1] Hair 1 = Absent 2 = Present

11. HEAD (at Maturity):

A. DENSITY

[2] 1 = Lax
2 = Middense (Laxidense)
3 = Dense

B. SHAPE

[1] 1 = Tapering
2 = Strap
3 = Clavate
4 = Other (SPECIFY):_____

C. CURVATURE

[2] 1 = Erect
2 = Inclined
3 = Recurved

D. AWNEDNESS

[3] 1 = Awnless
2 = Apically Awnletted
3 = Awnletted
4 = Awned

12. GLUMES (at Maturity):

A. COLOR

[1]
1 = White
2 = Tan
3 = Other (SPECIFY) : _____

B. SHOULDER

[4]
1 = Wanting 2 = Oblique
3 = Rounded 4 = Square
5 = Elevated 6 = Apiculate
7 = Other (SPECIFY): _____

C. SHOULDER WIDTH

[2]
1 = Narrow
2 = Medium
3 = Wide

D. BEAK

[2]
1 = Obtuse
2 = Acute
3 = Acuminate

E. BEAK WIDTH

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[2]
1 = Narrow
2 = Medium
3 = Wide

F. GLUME LENGTH

[2]
1 = Short (ca. 7mm)
2 = Medium (ca. 8mm)
3 = Long (ca. 9mm)

G. WIDTH

[2]
1 = Narrow (ca. 3mm)
2 = Medium (ca. 3.5mm)
3 = Wide (ca. 4mm)

13. SEED

A. SHAPE

[3]
1 = Ovate
2 = Oval
3 = Elliptical

B. CHEEK

[1]
1 = Rounded
2 = Angular

C. BRUSH

[1]
1 = Short
2 = Medium
3 = Long

[1]
1 = Not Collared
2 = Collared

D. CREASE

[1]
1 = Width 60% or less of Kernel
2 = Width 80% or less of Kernel
3 = Width Nearly as Wide as Kernel

[1]
1 = Depth 20% or less of Kernel
2 = Depth 35% or less of Kernel
3 = Depth 50% or less of Kernel

E. COLOR

[1]
1 = White
2 = Amber
3 = Red
4 = Other (SPECIFY): _____

F. TEXTURE

[2]
1 = Hard
2 = Soft
3 = Other (SPECIFY): _____

G. PHENOL REACTION (*see instructions*):

[1]
1 = Ivory
2 = Fawn
3 = Light Brown
4 = Dark Brown
5 = Black

H. SEED WEIGHT

[3][4] g/1000 seed (Whole number only)

I. GERM SIZE

[1]
1 = Small
2 = Midsize
3 = Large

14. Disease : (0=Not Tested; 1=Susceptible; 2=Resistant; 3=Intermediate; 4=Tolerant)

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PLEASE INDICATE THE SPECIFIC RACE OR STRAIN TESTED

[0]	Stem Rust *(Puccinia graminis* f. sp. *tritici)*	[2]	Leaf Rust *(Puccinia recondita* f. sp. *tritici)* + NRJ03
[0]	Stripe Rust *(Puccinia striiformis)*	[0]	Loose Smut *(Ustilago tritici)*
[0]	Tan Spot *(Pyrenophora tritici-repentis)*	[0]	Flag Smut *(Urocystis agropyri)*
[0]	Halo Spot *(Selenophoma donacis)*	[0]	Common Bunt *(Tilletia tritici* or *T. laevis)*
[0]	*Septoria nodorum* (Glume Blotch)	[0]	Dwarf Bunt *(Tilletia controversa)*
[0]	*Septoria avenae* (Speckled Leaf Disease)	[0]	Karnal Bunt *(Tilletia indica)*
[3]	*Septoria tritici* (Speckled Leaf Blotch) Natural infection in Michigan	[2]	Powdery Mildew *(Erysiphe graminis* f. sp. *tritici)* Virginia "PM03 Comp"
[1]	Scab (*Fusarium* spp.) Natural infection in Michigan	[0]	"Snow Molds"
[2]	"Black Point" (Kernel Smudge) Natural infection in Michigan	[0]	Common Root Rot *(Fusarium, Cochliobolus* and *Bipolaris* spp.*)*
[0]	Barley Yellow Dwarf Virus (BYDV)	[0]	Rhizoctonia Root Rot *(Rhizoctonia solani)*
[0]	Soilborne Mosaic Virus (SBMV)	[0]	Black Chaff *(Xanthomonas campestris* pv. *translucens)*
[3]	Wheat Yellow (Spindle Streak) Mosaic Virus Natural infection in Michigan	[0]	Bacterial Leaf Blight *(Pseudomonas syringae* pv. *syringae)*
[0]	Wheat Streak Mosaic Virus (WSMV)	[ ]	Other (SPECIFY) _____
[ ]	Other (SPECIFY) _____	[ ]	Other (SPECIFY) _____
[ ]	Other (SPECIFY) _____	[ ]	Other (SPECIFY) _____
[ ]	Other (SPECIFY) _____	[ ]	Other (SPECIFY) _____

15. INSECT: (0=Not Tested; 1=Susceptible; 2=Resistant; 3=Intermediate; 4=Tolerant)

PLEASE SPECIFY BIOTYPE (where needed)

[0]	Hessian Fly *(Mayetiola destructor)*	[ ]	Other (SPECIFY) _____
[0]	Stem Sawfly *(Cephus* spp.)	[ ]	Other (SPECIFY) _____
[0]	Cereal Leaf Beetle *(Oulema melanopa)*	[ ]	Other (SPECIFY) _____
[0]	Russian Aphid *(Diuraphis noxia)*	[ ]	Other (SPECIFY) _____

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15. INSECT: *Continued* (0=Not Tested; 1=Susceptible; 2=Resistant; 3=Intermediate; 4=Tolerant)

PLEASE SPECIFY BIOTYPE (where needed) 2003 00 259

0	Greenbug *(Schizaphis graminum)*		Other (SPECIFY) _____
0	Aphids		Other (SPECIFY) _____

16. ADDITIONAL INFORMATION ON ANY ITEM ABOVE, OR GENERAL COMMENTS

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MSU WHEAT QUALITY TESTING PROGRAM

Milling and Baking Test Results for
Selected Michigan-Grown Soft Wheats
Harvested in 2001

Perry K.W. Ng
Rick Ward
Ed Tanhehco

January 2002

Acknowledgments

Collaborating Laboratories:

Chelsea Milling Company, Chelsea, MI
Kellogg Company, Battle Creek, MI
King Milling Company, Lowell, MI
Knappen Milling Company, Augusta, MI
Mennel Milling Company, Fostoria, OH
Michigan State University, E. Lansing, MI
Nabisco Brands, Inc., Toledo, OH
Star of the West Milling Company, Frankenmuth, MI
USDA-ARS Soft Wheat Quality Laboratory, Wooster, OH

Financial Support:

GREEEN
Michigan State Millers' Association
Michigan Agricultural Experiment Station

MSU Wheat Quality Testing Program (MSU-WQTP)

Objectives

To improve MSU wheat quality (milling and baking attributes) via (1) coordinating quality evaluation by the Michigan wheat industry of advanced lines from strip trial tests and assessing acceptability for potential release, and (2) evaluating, at various levels, selected MSU wheat breeding lines for quality potential.

Description of the Year 2001 Testing Program

Seven Michigan-grown wheat varieties harvested in four locations (Isabella, Midland, Saginaw, and Sanilac) in July 2001 were provided by Dr. Ward. The wheat samples were first cleaned at a Michigan milling company's facility. The cleaned wheat samples were evaluated for soundness by Falling Number. Only one sample from Sanilac location had a low Falling Number value and it was discarded. All sound samples of the same variety from all locations were then composited into one, i.e., giving a total of seven composite samples. Composite grain samples were then milled in the Cereal Science Laboratory (CSL) at the Department of Food Science & Human Nutrition, MSU, by an experimental MLU-202 Buhler Mill using AACC Method 26-31. All flour streams (three breaks and three reductions) of each variety were blended in a large V-shaped rotating mixer. In addition to the flour streams, the bran and shorts were collected separately from each variety. All blended flour, bran and shorts samples from each of the seven varieties were sent to eight industrial and governmental collaborators (please see acknowledgments, p. 1) for quality analyses in October 2001. Some collaborators also requested wheat grain samples for their own milling evaluation. The collaborators were instructed that samples should be evaluated within three weeks upon receipt to avoid flour-aging changes. In the event scheduling prevented their laboratories from carrying out the evaluation within that time frame, it was requested that samples be kept in a refrigerator or freezer till analyses could be performed.

The MSU-WQTP agreed not to identify laboratories with their results. Hence, the designations Lab 1 to Lab 9, including the MSU-CSL, were used in the following graphs and tables.

Highlights of Results

Data received from all analyses of flour samples that were milled by the MSU-CSL MLU-202 Buhler Mill are presented in Sections I (cream colored sheets) and II (blue sheets). A small number of data obtained from flour samples milled by a Brabender Quadrumat Jr. Mill were denoted with an asterisk (*). Section I contains data in graph format to more visually compare the data. For more detailed comparison, Section II contains the actual data (in table format) used for plotting the graphs.

The data in both Sections I and II are presented in four segments: wheat grain properties, flour properties, dough properties, and baking properties. Different methods were used by different laboratories, thus, it was not possible to apply statistical analyses to these data. However, some trends can be observed for the seven varieties.

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Wheat Grain Properties:

The seven varieties appeared to be quite sound, i.e., fairly low degree of sprouted grain in the samples based on the Falling Number results. All seven varieties were classified as soft wheat, except for 25W60 which would fall into the medium soft class based on the AACC Method 55-31 for the Single Kernel Characterization System. All varieties appeared to have fairly good milling properties based on the straight-grade flour yield.

Flour Properties:

Damaged starch content was very low for all flour samples obtained by the Buhler Mill, though a bit higher in flour samples obtained from the Brabender Quadrumat Jr. Mill. On the other hand, mean flour particle size was slightly smaller for samples milled on the Brabender Quadrumat Jr. Mill. This would indicate a harsher grinding action of the Bradender Quadrumat Jr. Mill than the Buhler mill, resulting in a higher damaged starch content of those flour samples. Variety D8006 appeared to have a strong gluten strength for soft wheat based on Zeleny Sedimentation Value and lactic acid solvent retention capacity. On the other hand, this variety had only an average wet gluten content among the seven varieties. This would indicate that the proportion of glutenin in the total gluten for variety D8006 is much higher than that in the other six varieties.

Dough Properties:

Variety D8006 had the strongest dough properties among the varieties, based on Alveograph data.

Baking Properties:

Variety Caledonia flour appeared to produce the biggest cookie with the softest texture among the seven varieties tested.

General Comments

Wheat samples were first evaluated for soundness. This ensured that only sound samples were included in the testing program. In addition, a composite sample (from four locations) of each variety was evaluated to provide a more representative picture of wheat harvested in Michigan.

A collaborative study was carried out ahead of time among a few laboratories to determine a proper setting for the Buhler Mill for soft wheat milling so that a good flour extraction rate could be obtained with minimum starch damage to the flour. This was achieved and is reflected in the damaged starch and flour yield results.

It is recognized that certain laboratories can carry out certain analyses, and other laboratories cannot. The laboratories using a certain method for a specific test are indicated next to the relevant method in the list of procedures section (Section III, green sheets). Since each company/laboratory was free to use its customary procedure, each company was better able to judge the quality of each wheat sample relative to its usual acceptable wheat. Thus, the wheat quality data in this booklet would be very useful for the wheat industry to gain information about the wheat harvested in Michigan in 2001.

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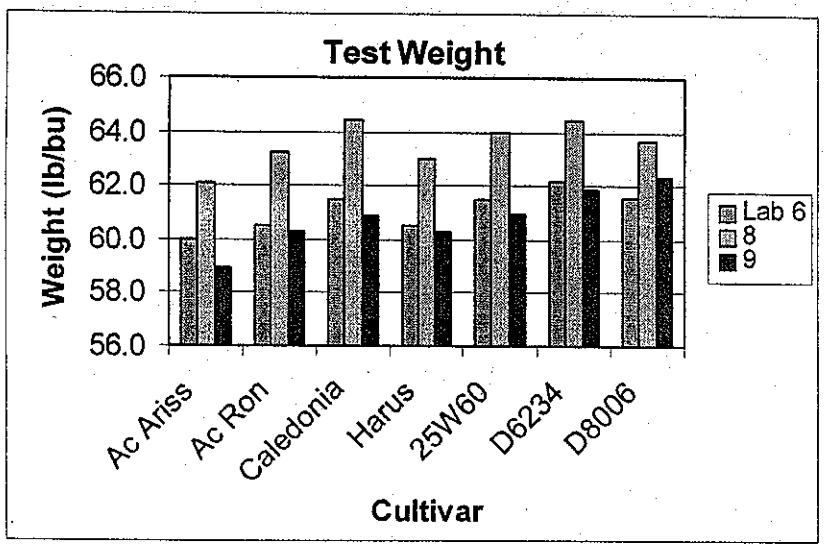
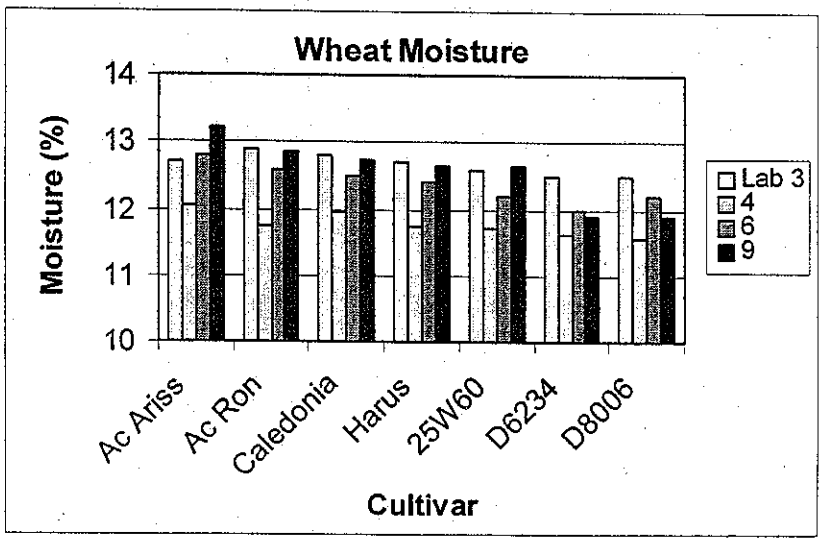
Section I

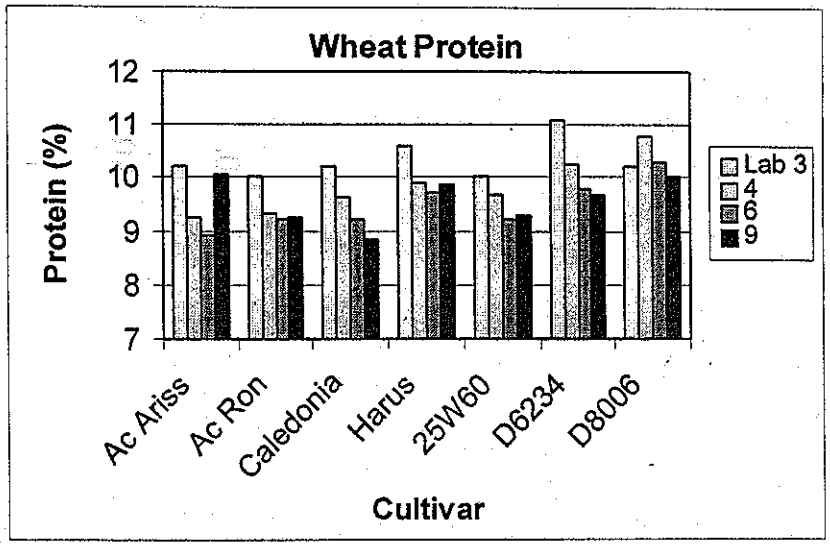
Data In Graph Format

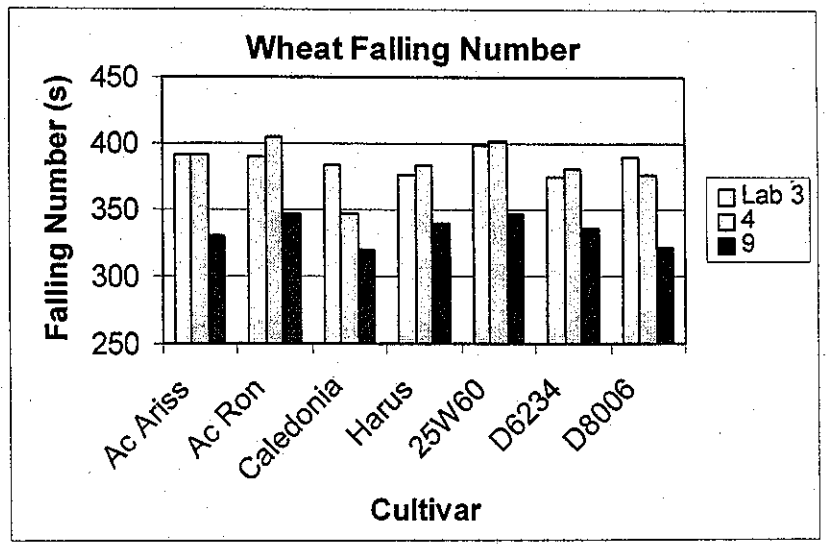
Section I-A

Wheat Properties









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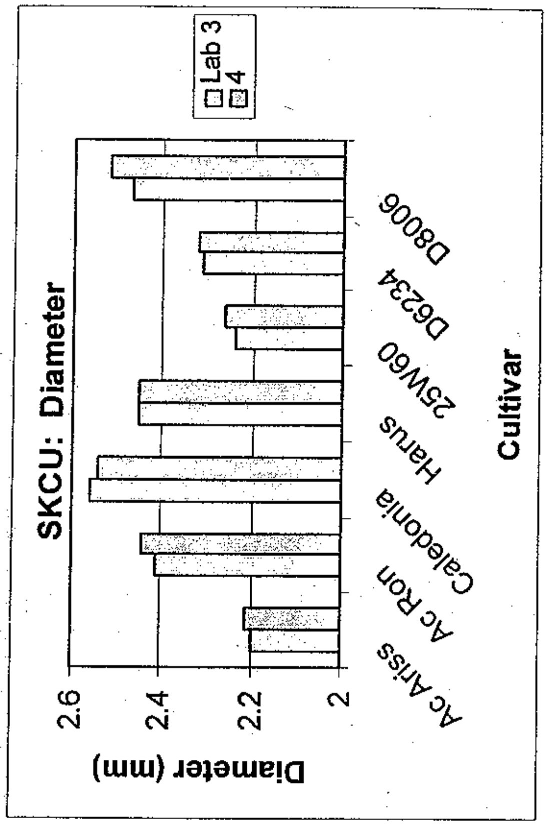
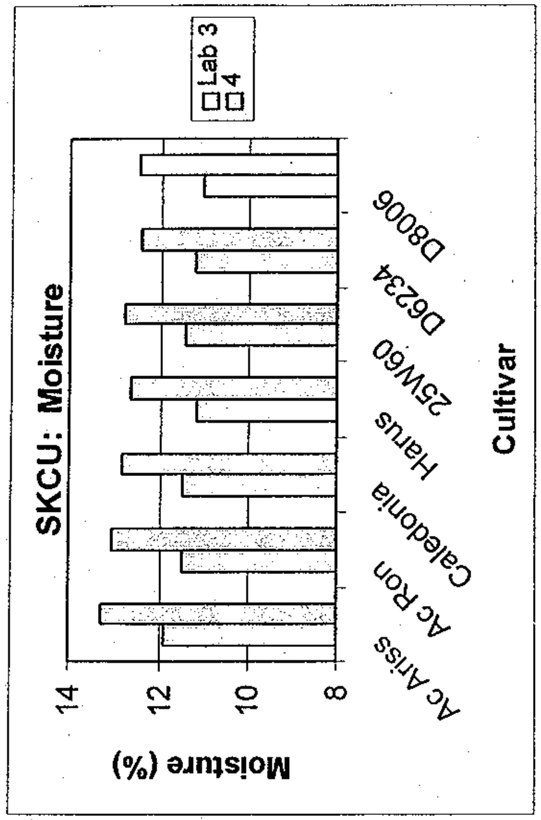
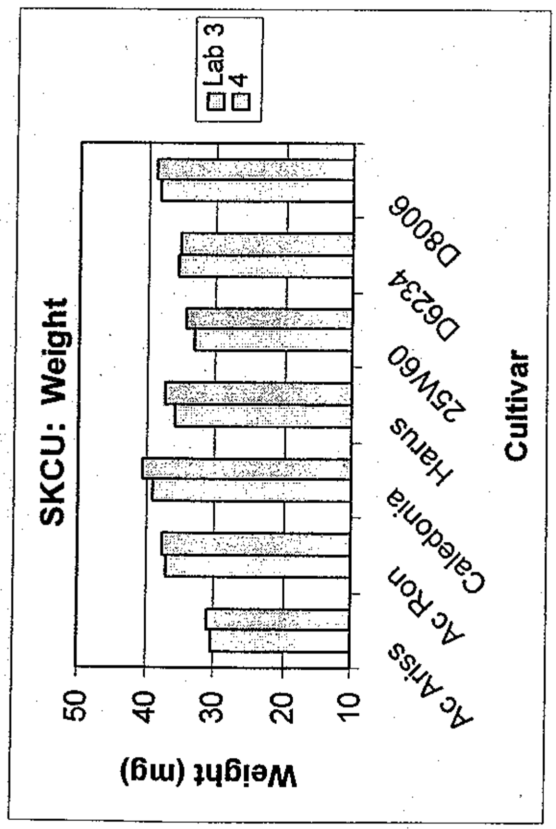
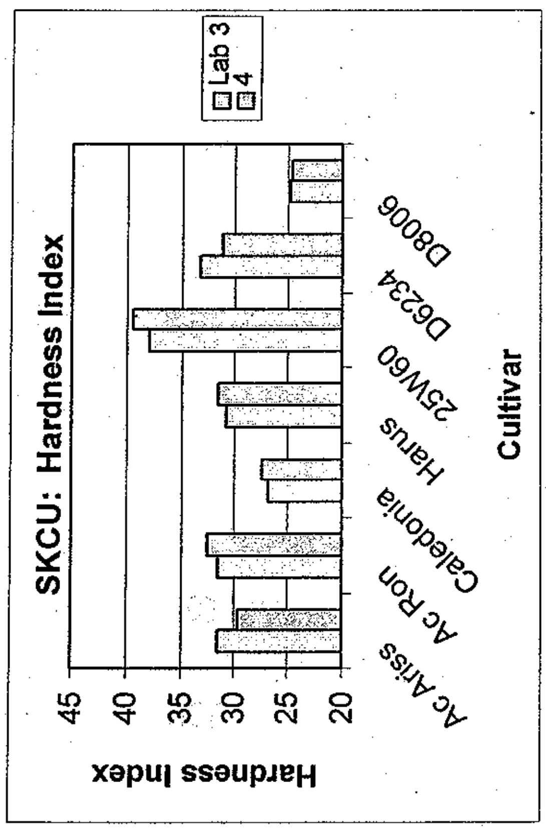
12

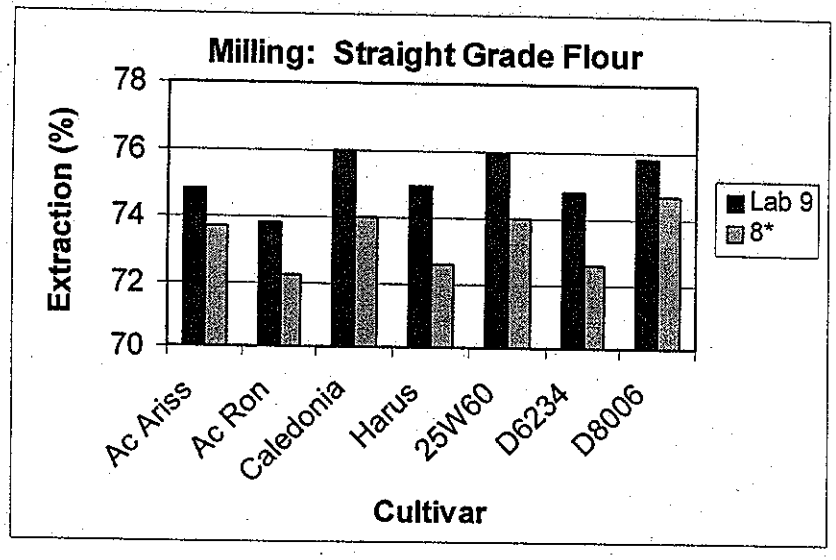
6

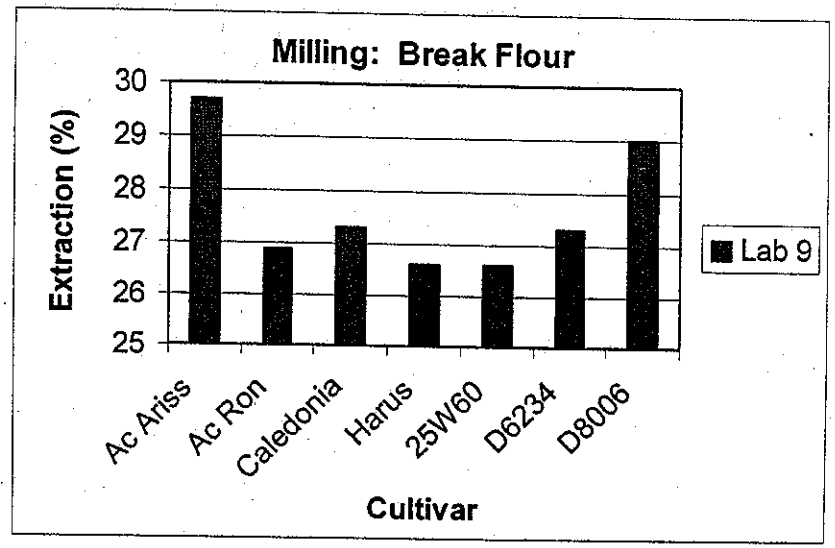

SKCU: Diameter
Diameter (mm)
2.6
2.4
2.2
2
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 3
4

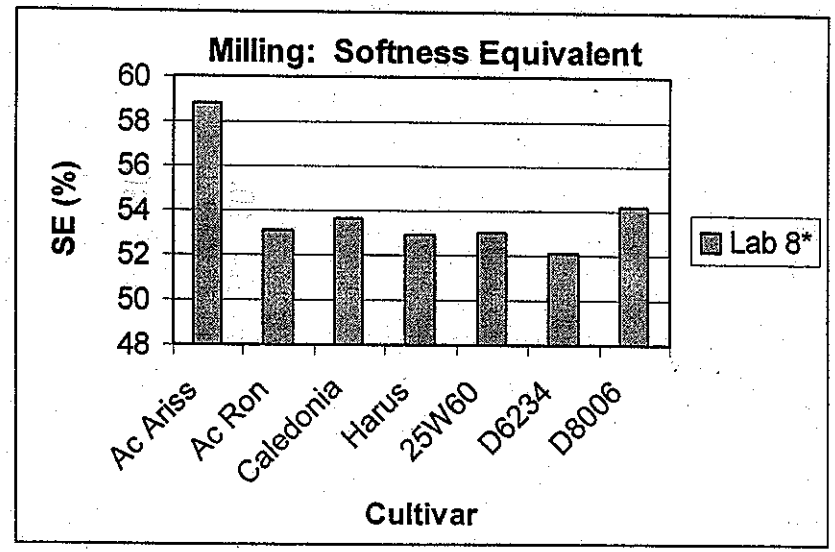

SKCU: Moisture
Moisture (%)
14
12
10
8
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 3
4


SKCU: Weight
Weight (mg)
50
40
30
20
10
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 3
4


SKCU: Hardness Index
Hardness Index
45
40
35
30
25
20
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 3
4







* Milled with Brabender Quadrumat Jr. Mill.

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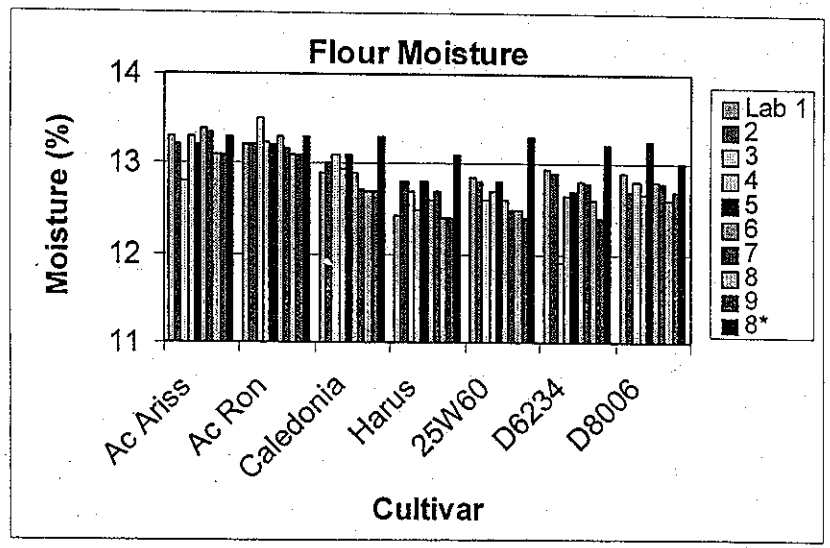
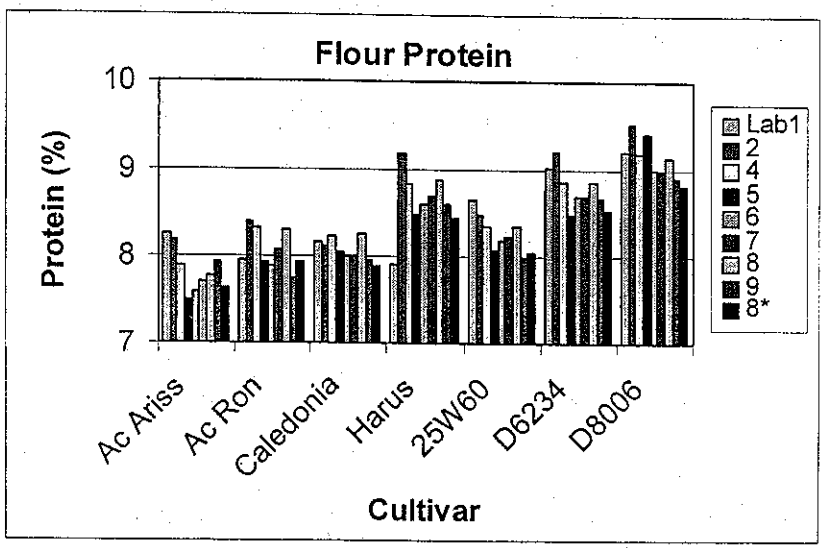
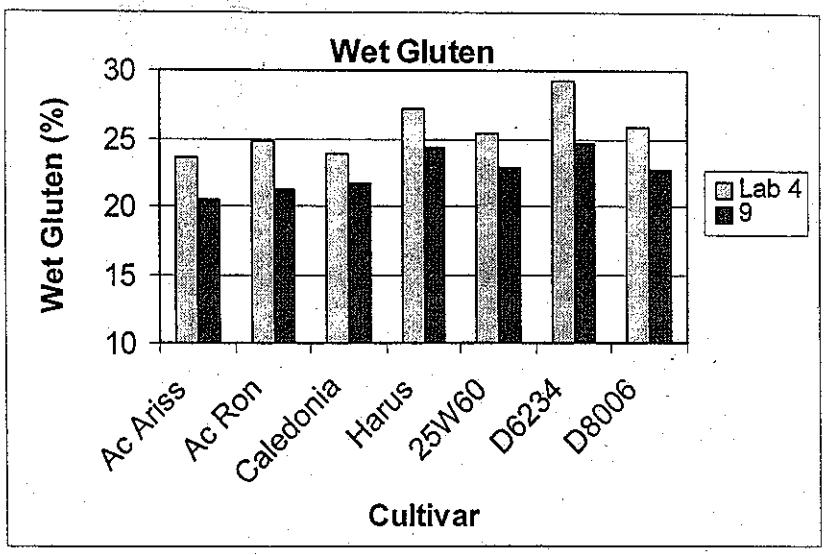
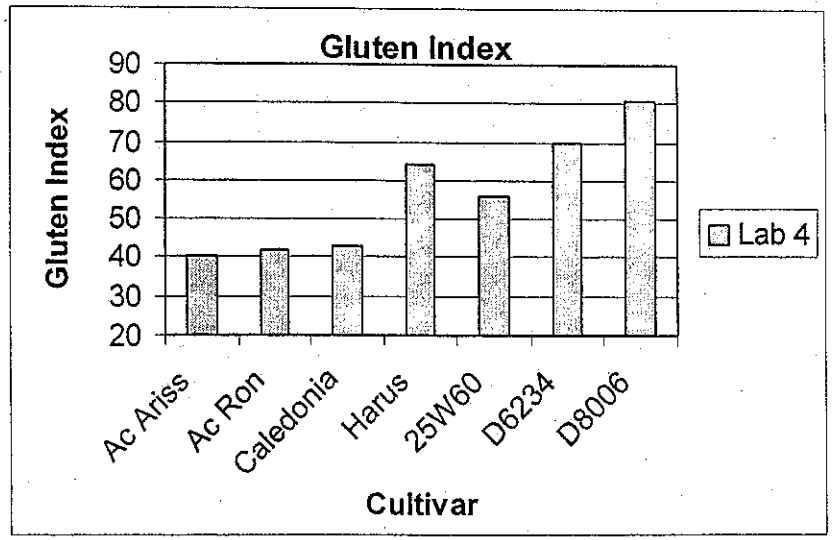
Section I-B

Flour Properties









* Milled with Brabender Quadrumat Jr. Mill.

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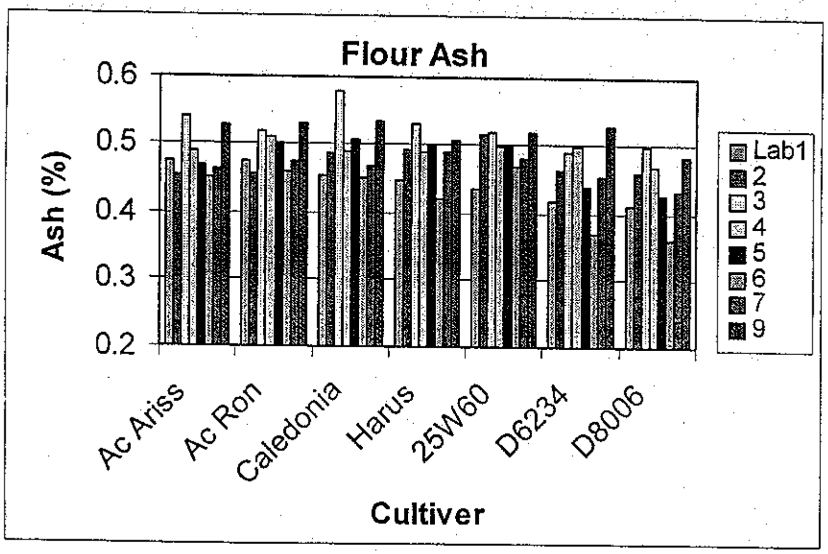
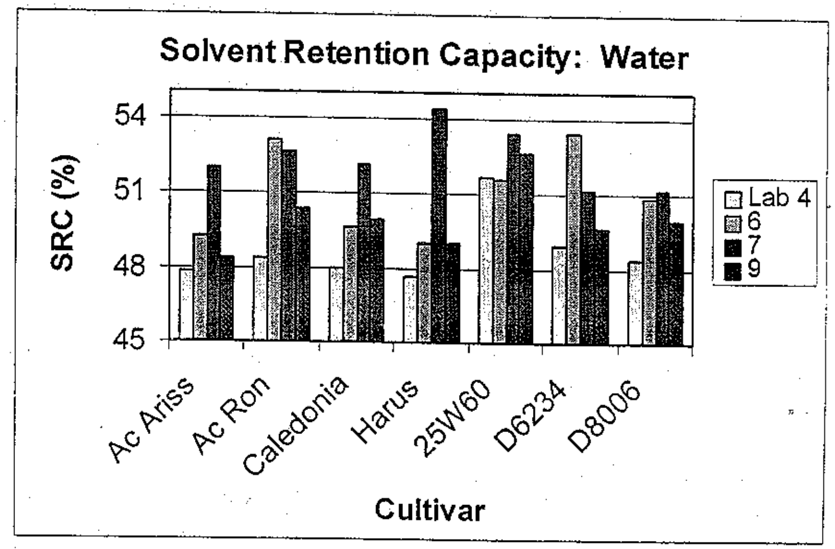
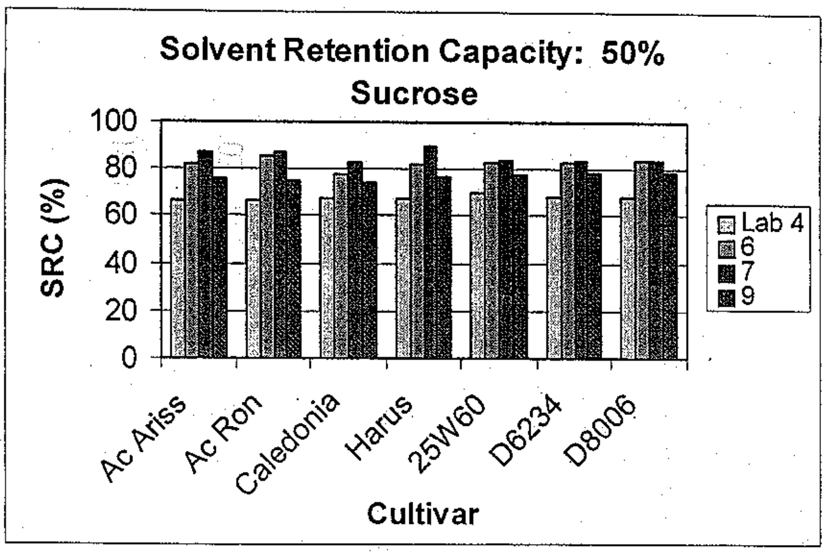
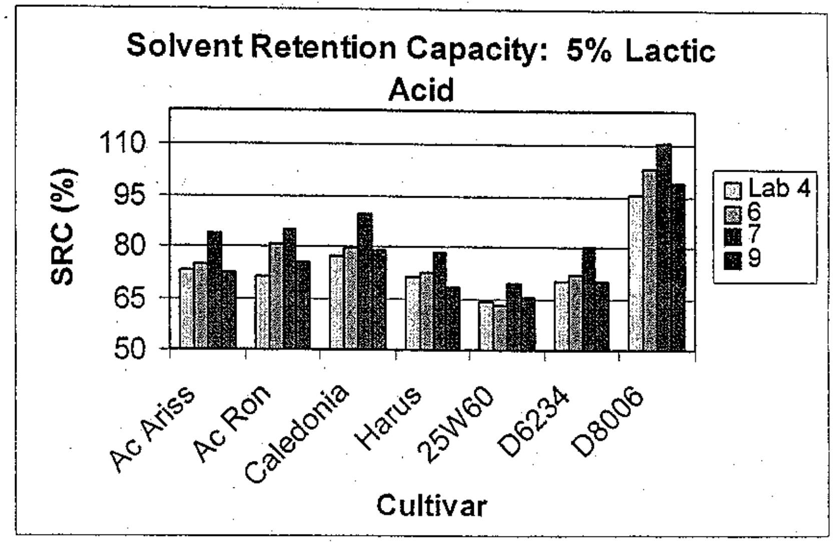

Flour Ash
Ash (%)
0.6
0.5
0.4
0.3
0.2
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultiver
Lab1
2
3
4
5
6
7
9


Solvent Retention Capacity: Water
SRC (%)
54
51
48
45
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 4
6
7
9


Solvent Retention Capacity: 50% Sucrose
SRC (%)
100
80
60
40
20
0
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 4
6
7
9


Solvent Retention Capacity: 5% Lactic Acid
SRC (%)
110
95
80
65
50
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 4
6
7
9

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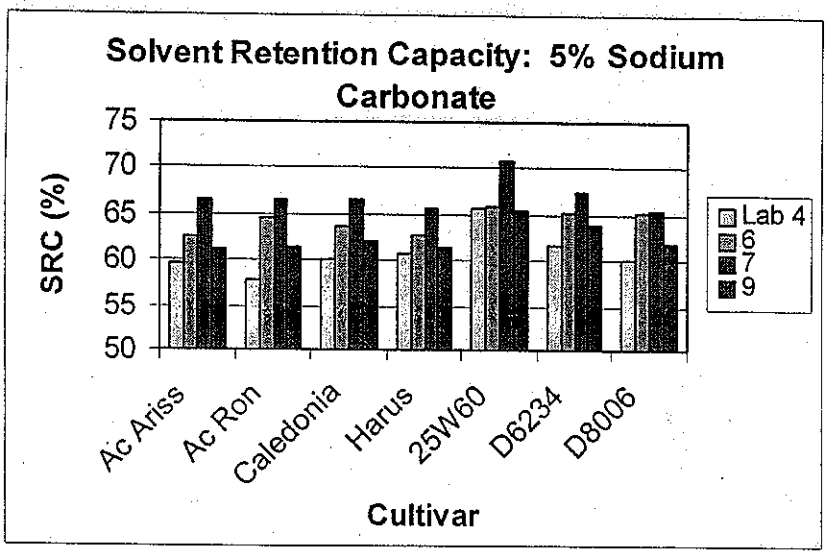

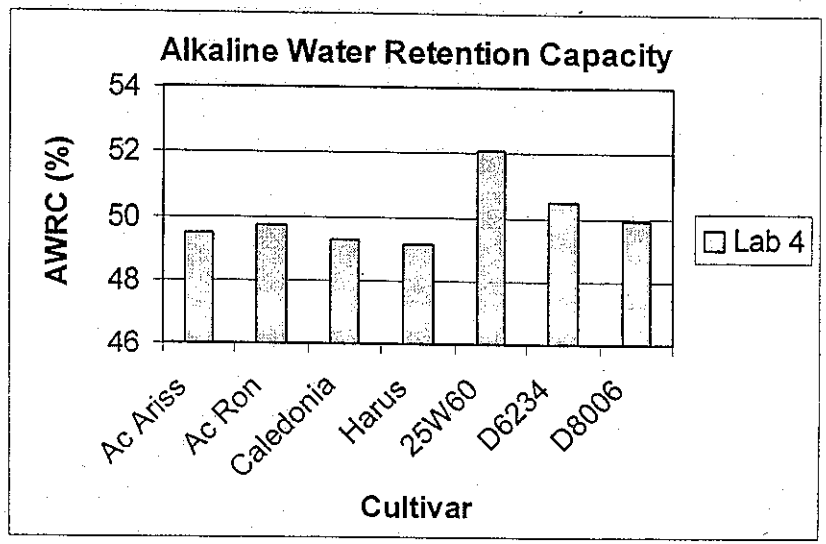

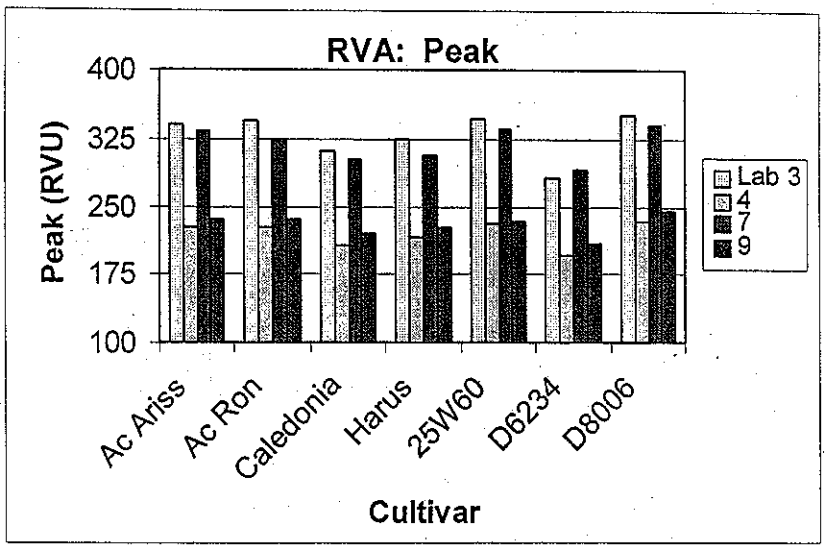

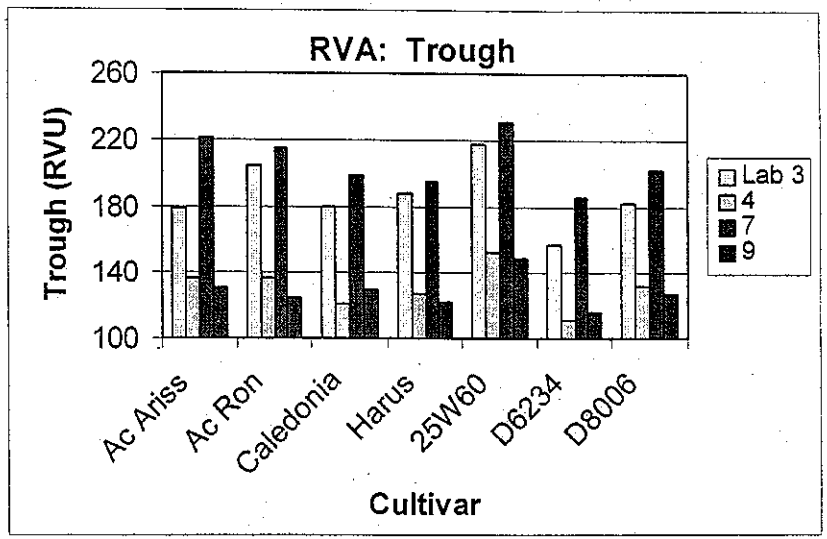

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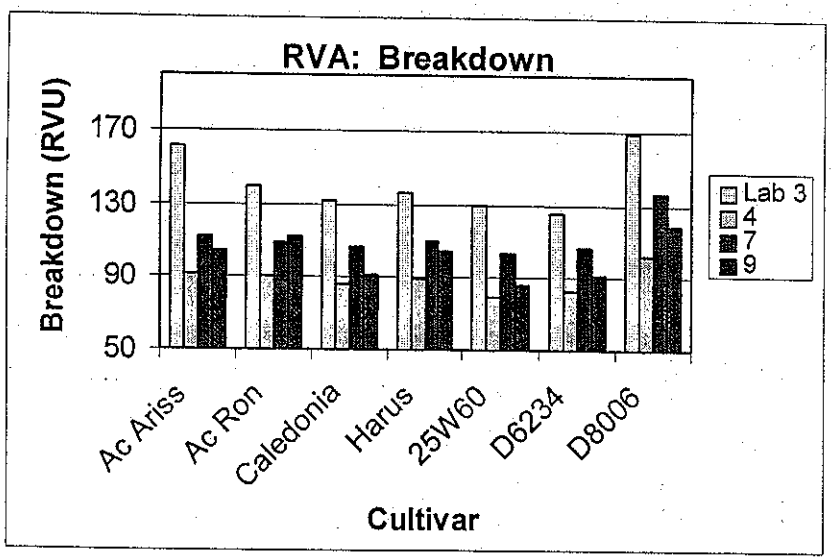
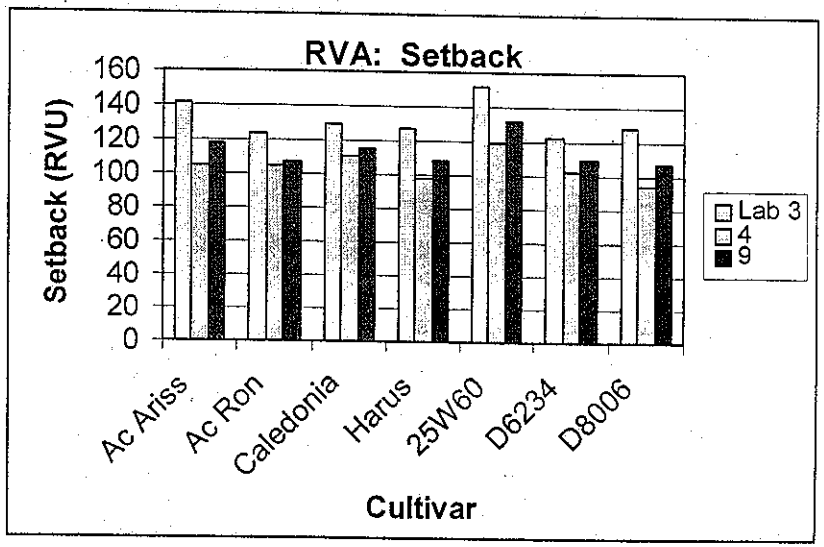
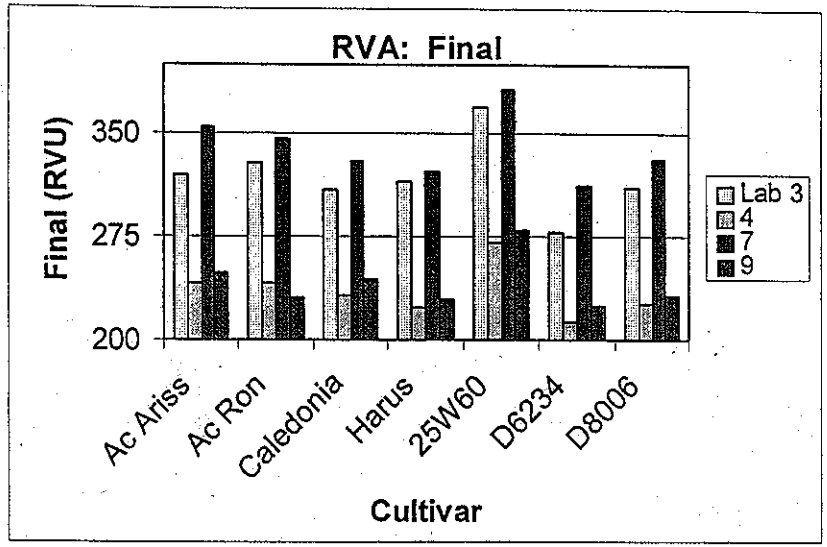
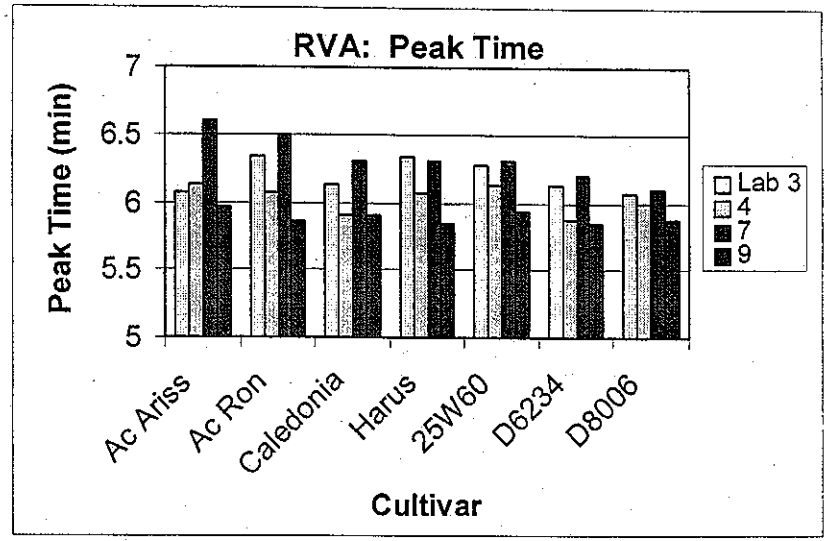

RVA: Breakdown
Breakdown (RVU)
170
130
90
50
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 3
4
7
9


RVA: Setback
Setback (RVU)
160
140
120
100
80
60
40
20
0
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 3
4
9


RVA: Final
Final (RVU)
350
275
200
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 3
4
7
9


RVA: Peak Time
Peak Time (min)
7
6.5
6
5.5
5
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 3
4
7
9

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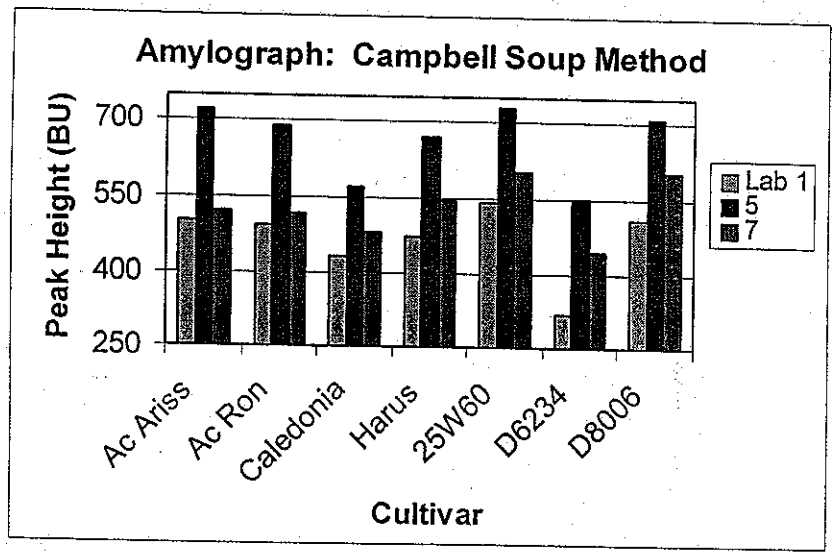
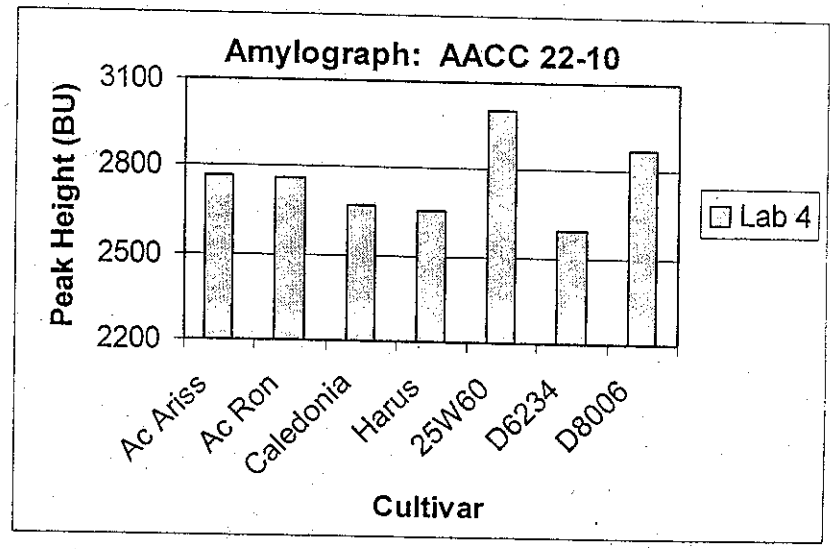
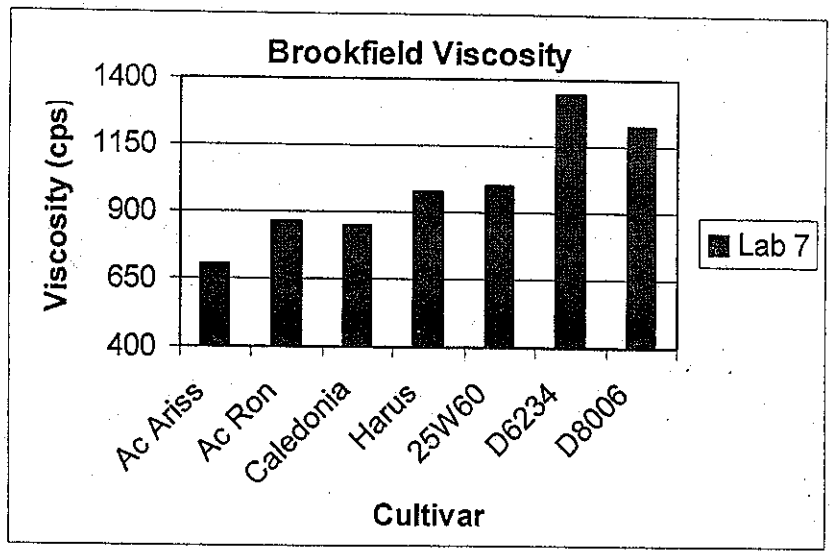
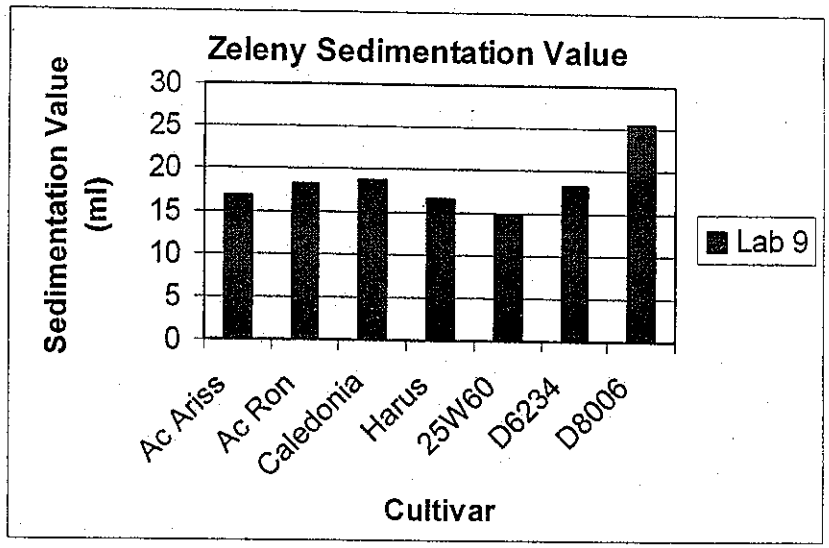
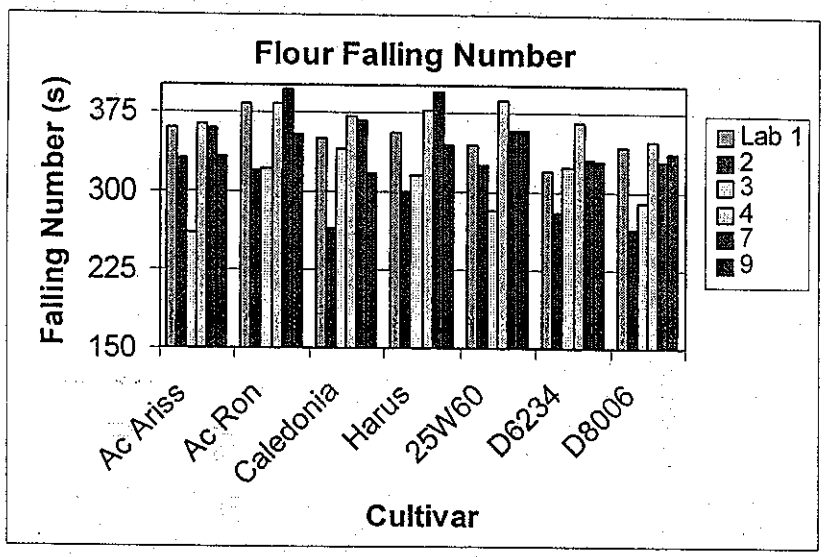

Amylograph: Campbell Soup Method
Peak Height (BU)
700
550
400
250
Lab 1
5
7
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar

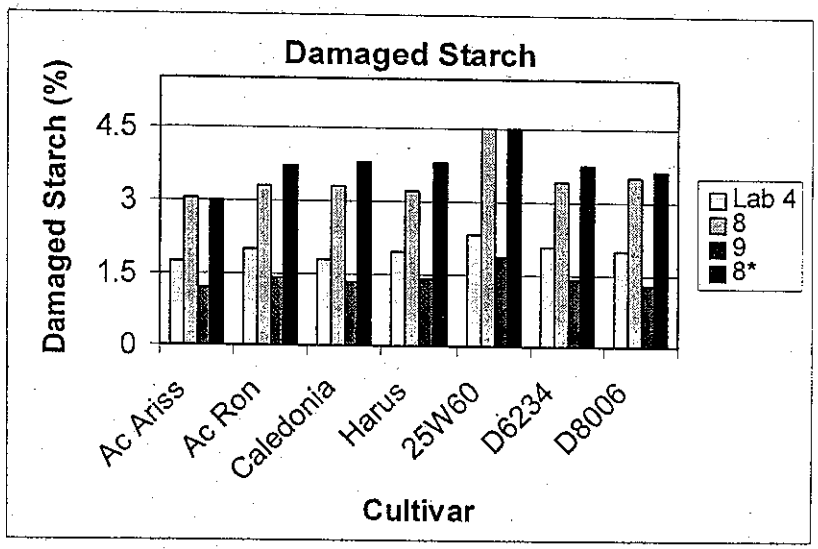

Amylograph: AACC 22-10
Peak Height (BU)
3100
2800
2500
2200
Lab 4
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar

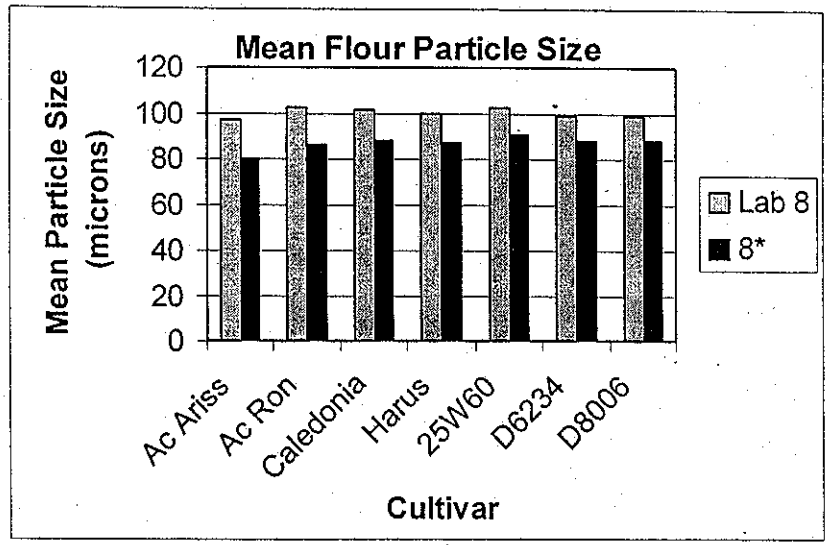

Brookfield Viscosity
Viscosity (cps)
1400
1150
900
650
400
Lab 7
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar

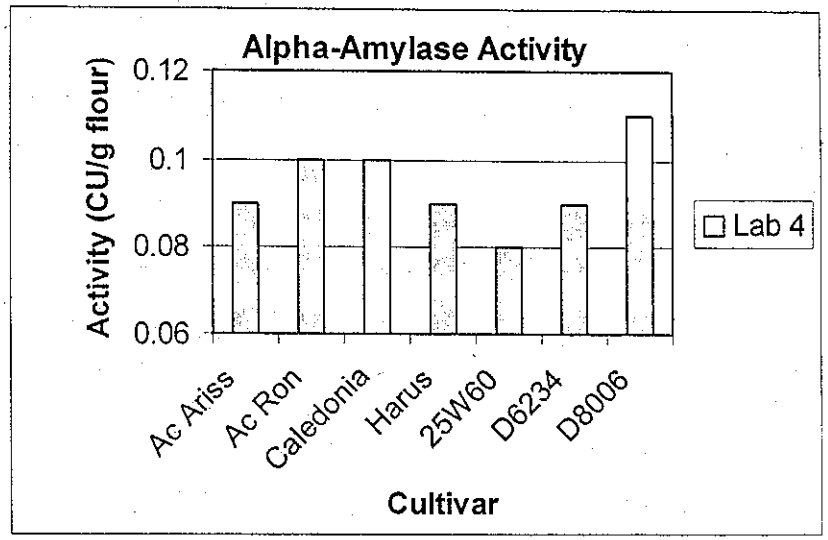

Zeleny Sedimentation Value
Sedimentation Value (ml)
30
25
20
15
10
5
0
Lab 9
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar

6,952,303



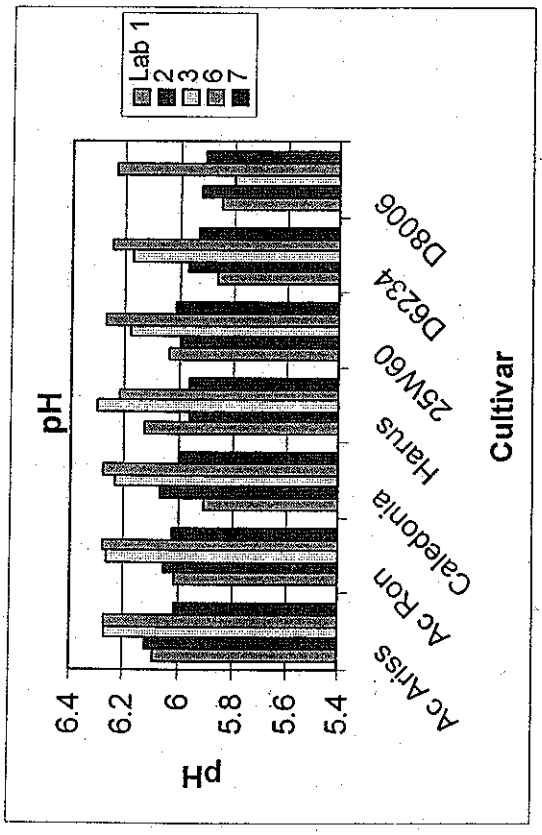






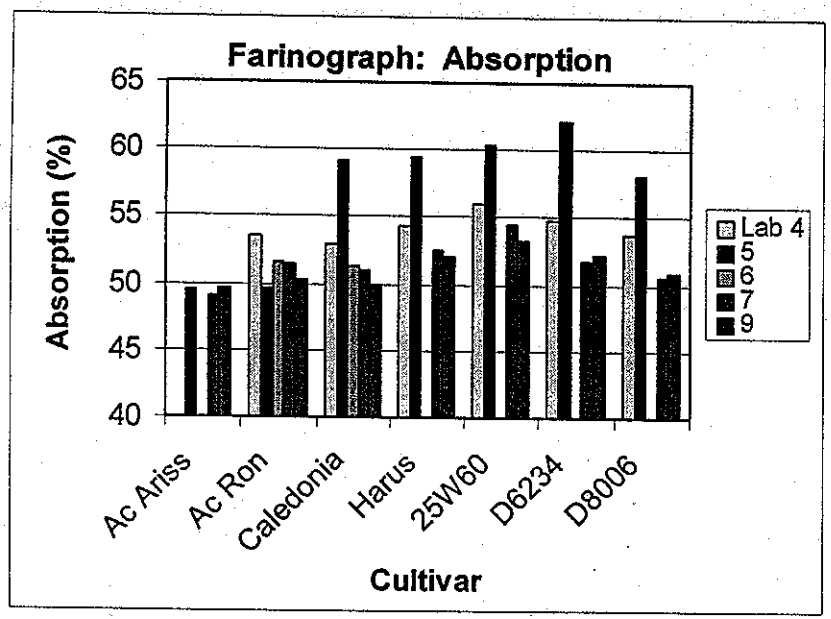
* Milled with Brabender Quadrumat Jr. Mill.

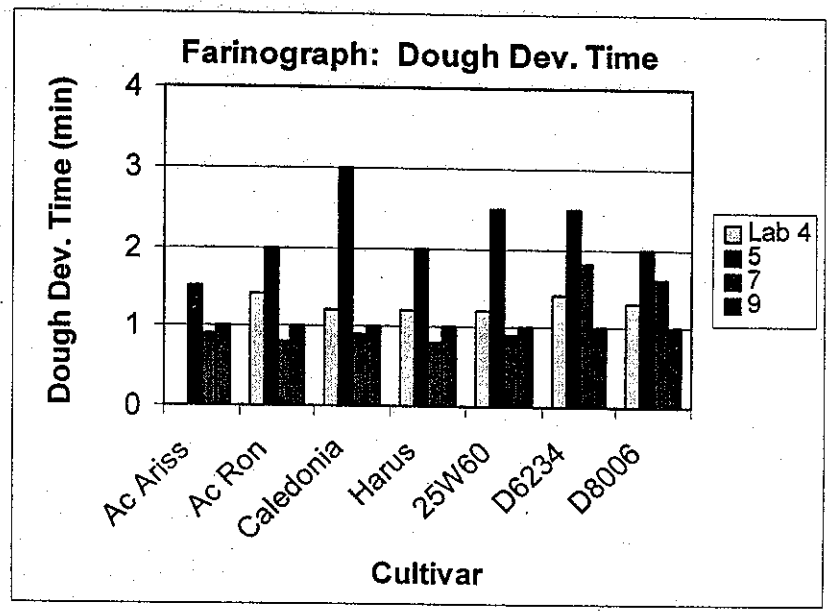
652 00 2003

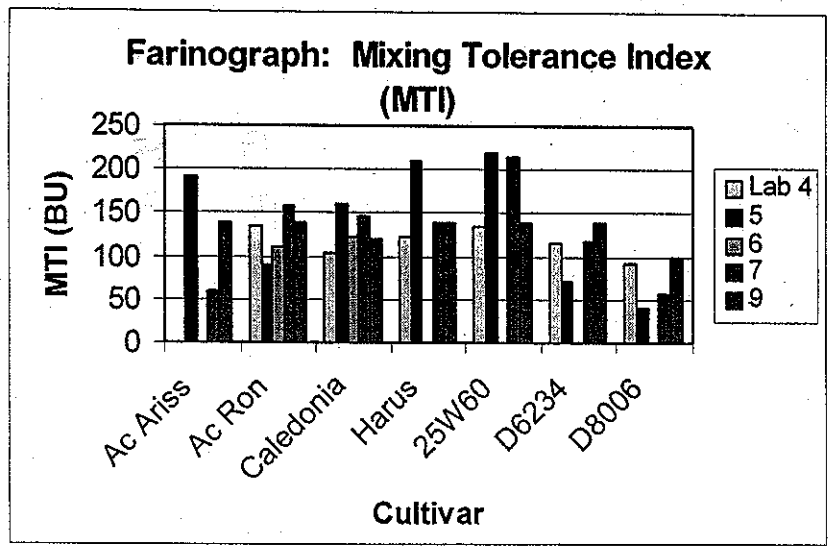

Lab 1
2
3
6
7
pH
6.4
6.2
6
5.8
5.6
5.4
pH
AC Ariss
AC Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar

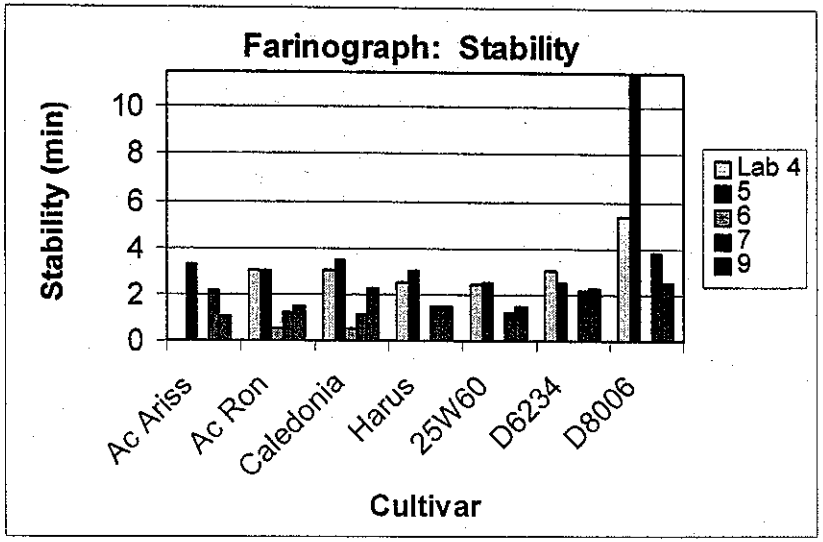
Section I-C

Dough Properties

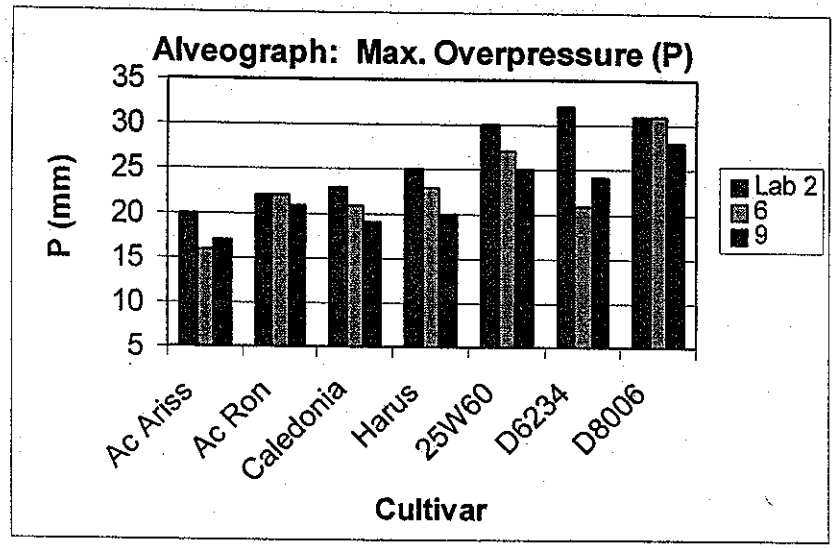

Farinograph: Absorption
Absorption (%)
65
60
55
50
45
40
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 4
5
6
7
9

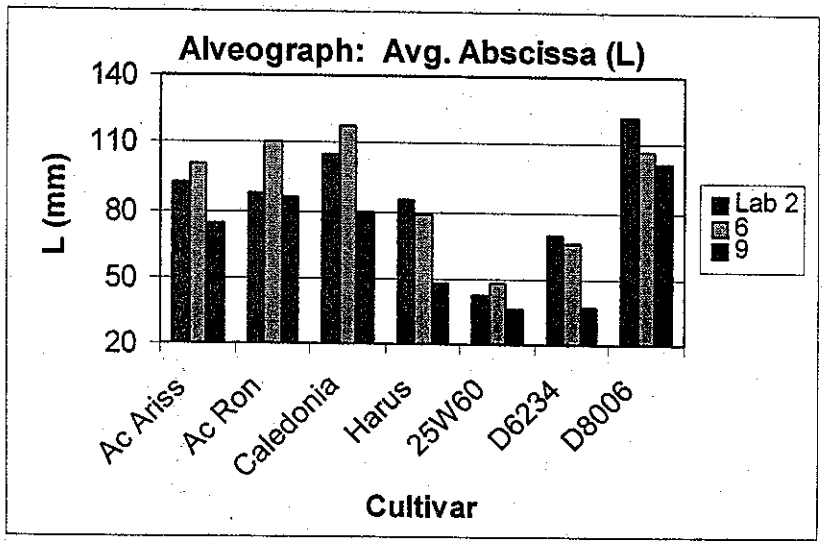

Farinograph: Dough Dev. Time
Dough Dev. Time (min)
4
3
2
1
0
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 4
5
7
9

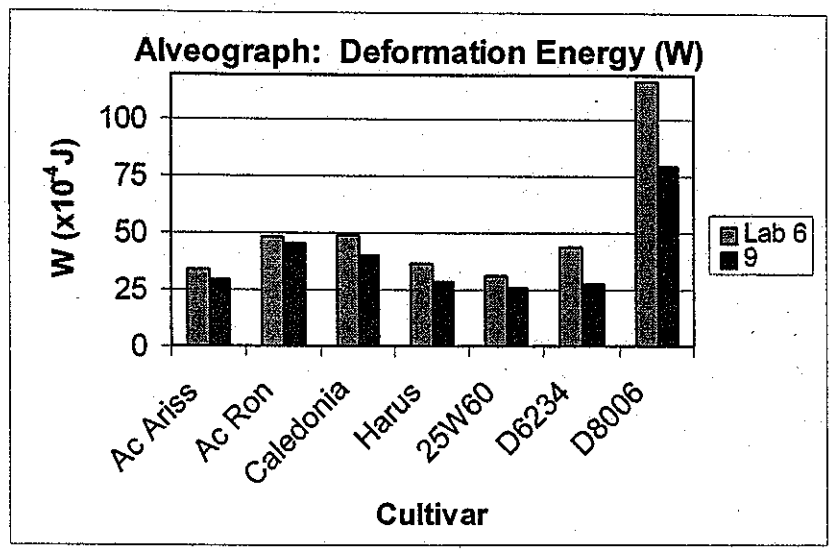

Farinograph: Mixing Tolerance Index (MTI)
MTI (BU)
250
200
150
100
50
0
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 4
5
6
7
9


Farinograph: Stability
Stability (min)
10
8
6
4
2
0
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 4
5
6
7
9

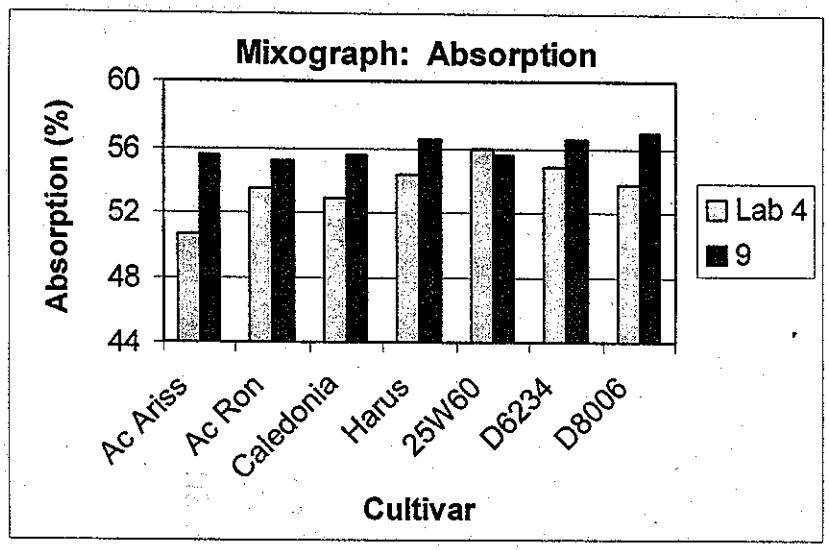
2003 0259

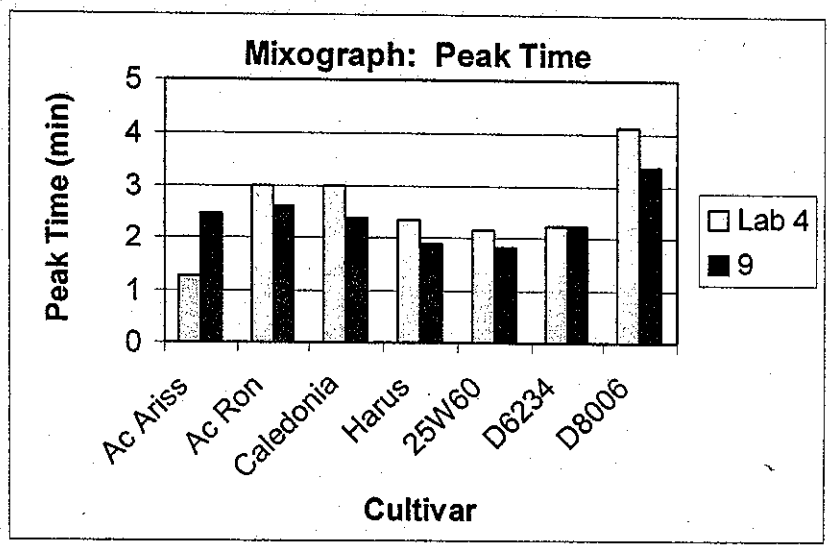

Alveograph: Max. Overpressure (P)
P (mm)
35
30
25
20
15
10
5
Lab 2
6
9
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar

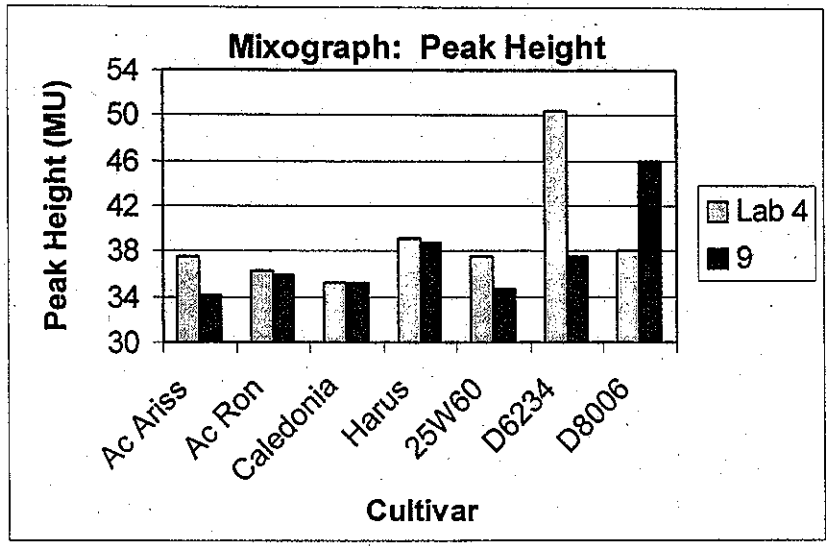

Alveograph: Avg. Abscissa (L)
L (mm)
140
110
80
50
20
Lab 2
6
9
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar


Alveograph: Deformation Energy (W)
W (x10⁻⁴J)
100
75
50
25
0
Lab 6
9
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar

692 00 2503


Mixograph: Absorption
Absorption (%)
60
56
52
48
44
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 4
9

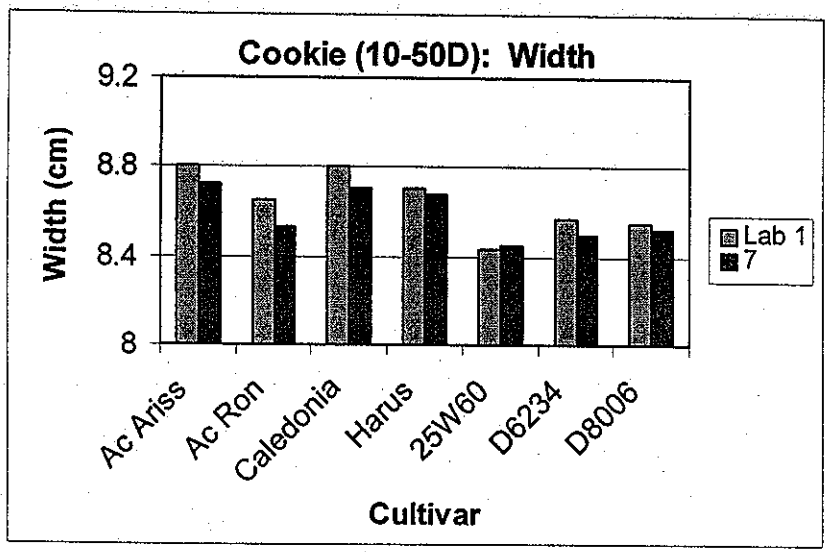

Mixograph: Peak Time
Peak Time (min)
5
4
3
2
1
0
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 4
9

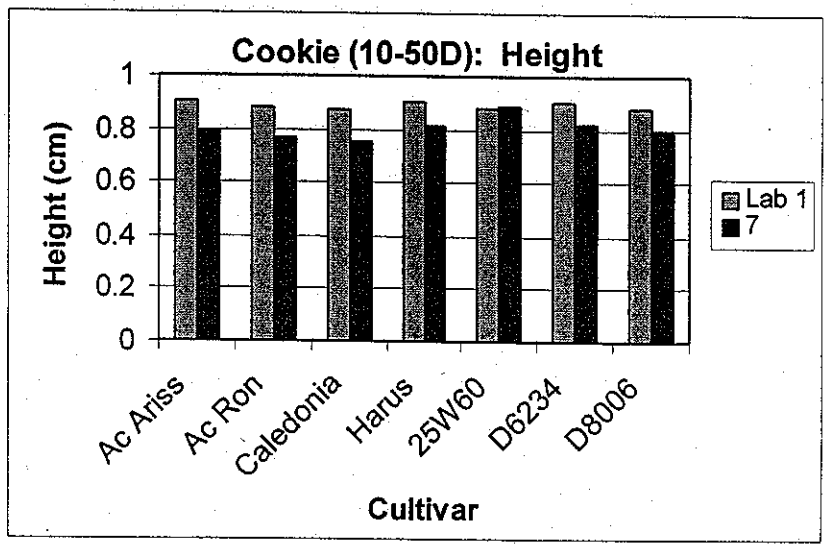

Mixograph: Peak Height
Peak Height (MU)
54
50
46
42
38
34
30
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 4
9

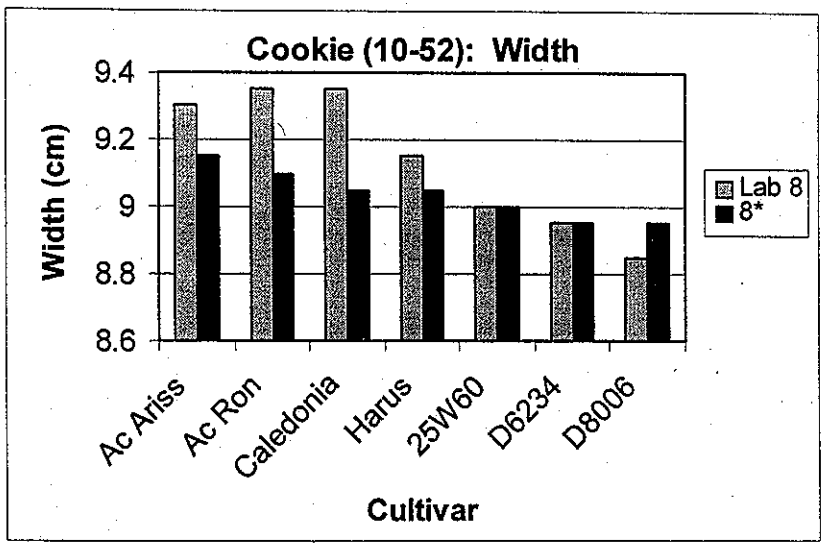
2003 0259

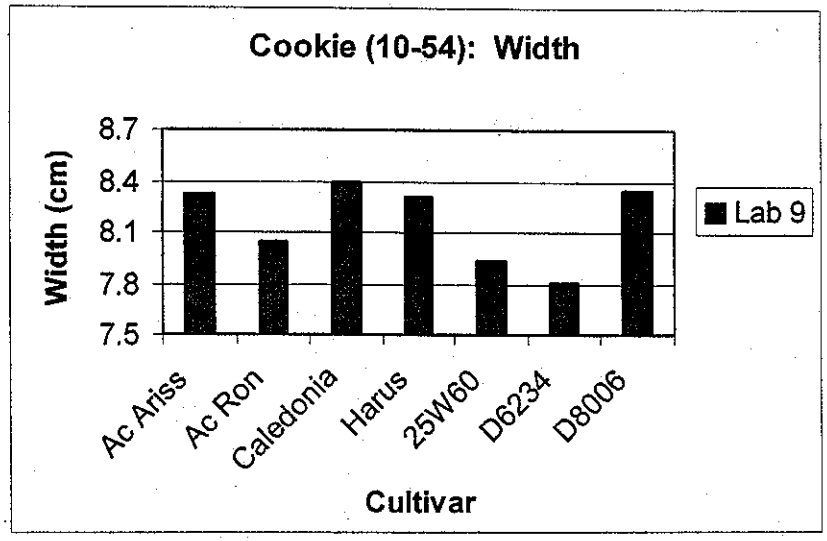
Section I-D

Baking Properties



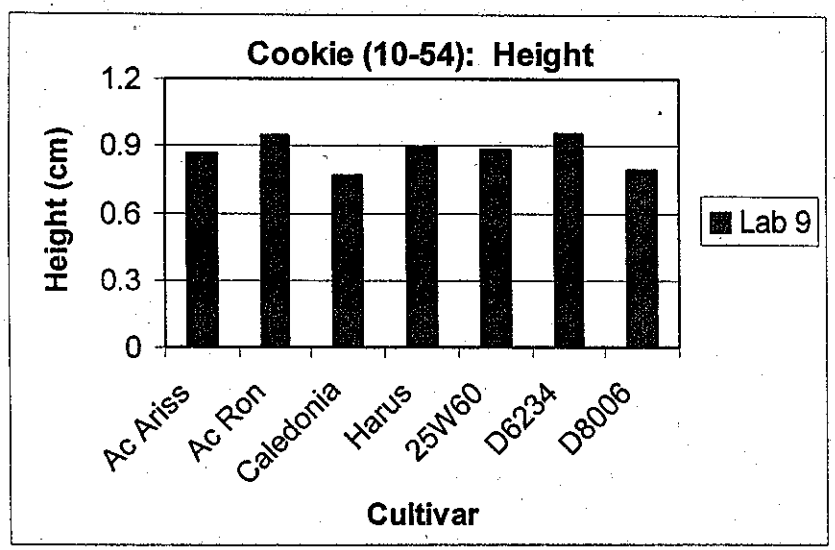


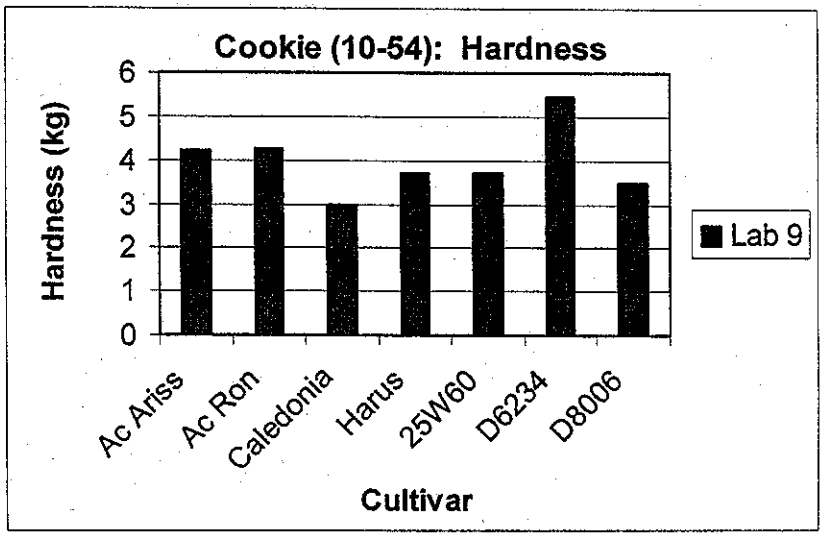




* Milled with Brabender Quadrumat Jr. Mill.

2003 00259


Cookie (10-54): Height
Height (cm)
1.2
0.9
0.6
0.3
0
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8008
Cultivar
Lab 9


Cookie (10-54): Hardness
Hardness (kg)
6
5
4
3
2
1
0
Ac Ariss
Ac Ron
Caledonia
Harus
25W60
D6234
D8006
Cultivar
Lab 9

2003 00 259

Section II

Data In Table Format

Wheat Grain							
Test Weight (lb/bu)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
6	60.0	60.5	61.5	60.5	61.5	62.2	61.6
8	62.1	63.2	64.4	63	64	64.4	63.7
9	58.9	60.3	60.9	60.3	61	61.9	62.3
Wheat Moisture (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	12.7	12.9	12.8	12.7	12.6	12.5	12.5
4	12.06	11.74	11.94	11.73	11.71	11.62	11.57
6	12.8	12.6	12.5	12.4	12.2	12.0	12.2
9	13.23	12.87	12.74	12.64	12.64	11.9	11.9
Wheat Protein (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	10.2	10	10.2	10.6	10	11.1	10.2
4	9.25	9.32	9.62	9.9	9.67	10.25	10.76
6	8.9	9.2	9.2	9.7	9.2	9.8	10.3
9	10.06	9.24	8.84	9.88	9.29	9.67	10.02
Wheat Falling Number (s)							
Lab 3	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	391	390	384	376	398	374	390
4	391	404	347	384	401	380	376
9	330	347	319	339	347	336	321
Single Kernel Characterization Unit: Weight (mg)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	30.38	36.72	38.94	35.76	32.84	35.32	38.17
4	30.91	37.61	40.47	37.22	34.19	35.04	38.66
SKCU: Diameter (mm)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	2.2	2.41	2.56	2.45	2.24	2.31	2.47
4	2.21	2.44	2.54	2.45	2.26	2.32	2.52
SKCU: Hardness Index							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	31.56	31.54	26.86	30.87	37.88	33.31	24.9

4	29.65	32.49	27.4	31.5	39.41	31.25	24.62
SKCU: Moisture (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	11.91	11.48	11.51	11.2	11.43	11.24	11.06
4	13.3	13.04	12.85	12.65	12.8	12.43	12.5
Whole Grain Total Dietary Fiber (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	10.92	8.45	7.94	9.69	8.16	7.49	8.04
Milling: Straight Grade Flour Extraction (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
9	74.8	73.8	76	74.9	75.9	74.8	75.8
8*	73.7	72.2	74	72.6	74	72.6	74.7
Milling: Break Flour Extraction (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
8*	29.7	26.9	27.3	26.6	26.6	27.3	29
Milling: Softness Equivalent (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
8*	58.8	53.1	53.6	52.9	53	52.1	54.2

* Milled with Brabender Quadrumat Jr. Mill.

Flour							
Flour Moisture (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
1	13.3	13.2	12.89	12.43	12.84	12.95	12.89
2	13.20	13.20	13.00	12.80	12.80	12.90	12.70
3	12.8	13.5	13.1	12.7	12.6	11.9	12.8
4	13.29	13.24	12.94	12.48	12.69	12.65	12.67
5	13.2	13.2	13.1	12.8	12.8	12.7	13.25
6	13.4	13.3	12.9	12.6	12.6	12.8	12.8
7	13.34	13.16	12.71	12.69	12.50	12.78	12.78
8	13.1	13.1	12.7	12.4	12.5	12.6	12.6
9	13.1	13.1	12.7	12.4	12.4	12.4	12.7
8*	13.3	13.3	13.3	13.1	13.3	13.2	13
Flour Protein (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
1	8.26	7.96	8.16	7.92	8.64	9.02	9.2
2	8.18	8.39	8.13	9.18	8.50	9.19	9.52
4	7.9	8.32	8.23	8.84	8.36	8.86	9.17
5	7.5	7.95	8.05	8.48	8.08	8.49	9.4
6	7.6	7.9	8.0	8.6	8.2	8.7	9.0
7	7.72	8.08	8.00	8.69	8.23	8.70	8.97
8	7.79	8.31	8.27	8.88	8.34	8.85	9.13
9	7.95	7.75	7.96	8.61	7.98	8.67	8.9
8*	7.65	7.94	7.89	8.44	8.06	8.54	8.8
Wet Gluten (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	23.53	24.79	23.89	27.16	25.36	29.3	25.77
9	20.52	21.24	21.67	24.38	22.8	24.63	22.64
Gluten Index							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	40.36	41.52	42.71	64.11	55.67	69.71	80.68
Flour Ash (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
1	0.475	0.476	0.454	0.448	0.437	0.417	0.413
2	0.453	0.456	0.486	0.493	0.516	0.463	0.460
3	0.54	0.52	0.58	0.53	0.52	0.49	0.5
4	0.49	0.51	0.49	0.49	0.5	0.5	0.47
5	0.469	0.501	0.506	0.499	0.499	0.439	0.426

6	0.45	0.46	0.45	0.42	0.47	0.37	0.36
7	0.464	0.474	0.468	0.490	0.482	0.454	0.432
9	0.5271	0.5319	0.5343	0.5085	0.518	0.5269	0.4849
Solvent Retention Capacity: Water (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	47.78	48.38	47.94	47.65	51.66	48.92	48.34
6	49.24	53.08	49.65	49.02	51.54	53.38	50.86
7	51.92	52.56	52.09	54.39	53.41	51.15	51.15
9	48.4	50.34	49.99	48.99	52.64	49.68	49.99
Solvent Retention Capacity: 50% Sucrose (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	66.1	66.67	66.82	67.17	69.86	68.24	67.73
6	81.84	85.67	77.69	81.58	83.16	83.11	83.55
7	86.78	87.01	83.09	89.44	83.62	83.77	83.34
9	76.1	75.07	73.87	76.94	77.33	78.25	78.46
Solvent Retention Capacity: 5% Lactic Acid (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	72.81	71.34	77.3	71.26	64.12	69.71	95.09
6	74.79	80.45	79.29	72.52	62.98	71.60	103.13
7	83.72	84.77	89.65	78.07	69.58	80.24	110.78
9	72.33	75.02	79.1	68.5	65.06	70.13	99.06
Solvent Retention Capacity: 5% Sodium Carbonate (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	59.63	57.82	59.99	60.8	65.68	61.67	59.94
6	62.43	64.49	63.56	62.77	65.95	65.18	65.26
7	66.42	66.41	66.58	65.72	70.67	67.51	65.34
9	61.2	61.39	62.14	61.3	65.36	63.91	61.89
Alkaline Water Retention Capacity (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	49.45	49.73	49.29	49.15	52.05	50.45	49.92
RVA: Peak (RVU)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	340.83	345	311.67	324.58	347.67	282	351.67
4	227.75	227.42	207	216.5	232.08	194.75	234.25

7	333.67	324.67	302.58	306.00	334.92	291.42	339.08
9	235.25	235.54	220.21	226.38	234	208.05	244.71
RVA: Trough (RVU)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	178.67	205.08	179.67	187.67	217.42	156.58	182.33
4	136.17	136.67	120.83	127	152.17	111.42	131.75
7	221.17	216.08	198.08	195.50	231.58	184.83	202.33
9	130.63	123.55	128.59	121.1	147.75	116.21	126
RVA: Breakdown (RVU)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	162.17	139.92	132	136.92	130.25	125.42	169.33
4	91.58	90.75	86.17	89.5	79.92	83.33	102.5
7	112.50	108.58	106.50	110.50	103.33	106.58	136.75
9	104.63	111.99	91.63	105.27	86.25	91.83	118.71
RVA: Setback (RVU)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	141.08	123.58	129.33	127.33	151.58	121.83	128.33
4	104.5	105	111.08	97.25	119	102.42	94.17
9	117.58	107.55	115.38	108.19	131.38	109.46	106.92
RVA: Final (RVU)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	319.75	328.67	309	315	369	278.42	310.67
4	240.67	241.67	231.92	224.25	271.17	213.83	225.92
7	354.75	346.00	328.83	321.50	382.75	312.33	330.50
9	248.21	231.11	243.96	229.3	279.13	225.67	232.92
RVA: Peak Time (min)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
3	6.07	6.33	6.13	6.33	6.27	6.13	6.07
4	6.13	6.06	5.9	6.06	6.13	5.87	6
7	6.6	6.5	6.3	6.3	6.3	6.2	6.1
9	5.97	5.86	5.9	5.85	5.93	5.84	5.87
Amylograph Peak Height: Campbell Soup Method (BU)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
1	500	490	430	470	540	320	510

5	720	690	570	670	730	550	710
7	520	515	480	545	600	445	600
Amylograph Peak Height: AACC Method 22-10 (BU)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	2768	2758	2671	2655	3000	2597	2874
Brookfield Viscosity (cps)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
7	700	863	850	975	1000	1350	1225
Zeleny Sedimentation Value (ml)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
9	16.7	18.1	18.6	16.6	14.6	18.1	25.6
Flour Falling Number (s)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
1	359	383	350	356	344	318	341
2	330	319	264	300	324	279	264
3	260	320	340	314	281	322	290
4	364	382	371	376	387	365	348
7	360	397	367	395	358	331	329
9	332	353	317	344	357	329	336
Damaged Starch (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	1.76	1.99	1.81	1.96	2.34	2.09	2.02
8	3.03	3.29	3.31	3.22	4.5	3.43	3.48
9	1.22	1.4	1.34	1.43	1.89	1.4	1.3
8*	3	3.69	3.79	3.78	4.48	3.77	3.63
Flour Particle Size (microns)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
8	96.5	102.3	101.3	99.9	102.4	98.7	98.7
8*	80.1	86.3	88.4	87.1	90.8	87.7	87.8
Alpha-Amylase Activity (CU/g Flour)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	0.09	0.1	0.1	0.09	0.08	0.09	0.11

pH							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
1	6.09	6.01	5.91	6.13	6.04	5.86	5.85
2	6.12	6.05	6.07	5.96	5.99	5.97	5.92
3	6.27	6.26	6.23	6.3	6.18	6.17	5.8
6	6.27	6.28	6.28	6.22	6.27	6.25	6.23
7	6.01	6.02	6.00	5.96	6.01	5.93	5.91

* Milled with Brabender Quadrumat Jr. Mill.

Dough							
Farinograph: Absorption (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4		53.5	52.9	54.3	55.9	54.8	53.7
5	49.5	49.6	59.2	59.4	60.4	62.2	58
6		51.6	51.3				
7	49.0	51.5	51.0	52.5	54.5	51.8	50.5
9	49.6	50.2	49.9	52	53.2	52.2	50.8
Farinograph: Dough Development Time (min)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4		1.4	1.2	1.2	1.2	1.4	1.3
5	1.5	2	3	2	2.5	2.5	2
7	0.9	0.8	0.9	0.8	0.9	1.8	1.6
9	1	1	1	1	1	1	1
Farinograph: Mixing Tolerance Index (BU)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4		135	104	123	135	116	91
5	190	90	160	210	220	70	40
6		112	122				
7	59	157	147	140	214	118	57
9	140	140	120	140	140	140	100
Farinograph: Stability (min)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4		3	3	2.5	2.4	3	5.4
5	3.25	3	3.5	3	2.5	2.5	11.5
6		0.5	0.5				
7	2.2	1.2	1.1	1.5	1.2	2.2	3.8
9	1	1.5	2.25	1.5	1.5	2.25	2.5
Alveograph: Maximum Overpressure - P (mm)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
2	20	22	23	25	30	32	31
6	16	22	21	23	27	21	31
9	17	21	19	20	25	24	28
Alveograph: Average Abscissa - L (mm)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
2	92	88	105	85	43	70	122

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6	100	110	117	79	48	66	107
9	74	86	80	48	36	37	101
Alveograph: Deformation Energy - W ($x10^{-4}$J)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
6	34	48	49	37	31	44	117
9	30	46	40	29	26	28	80
Mixograph: Absorption (%)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	50.7	53.5	52.9	54.3	55.9	54.8	53.7
9	55.53	55.23	55.54	56.52	55.57	56.61	56.96
Mixograph: Peak Time (min)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	1.25	3.01	3	2.33	2.16	2.22	4.13
9	2.47	2.6	2.4	1.91	1.81	2.23	3.37
Mixograph: Peak Height (MU)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
4	37.5	36.2	35.2	39.2	37.5	50.45	38.1
9	34.2	36	35.2	38.8	34.7	37.5	46

Baking							
Cookie (10-50D): Width (cm)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
1	8.8	8.65	8.8	8.7	8.43	8.57	8.55
7	8.72	8.53	8.70	8.68	8.45	8.50	8.52
Cookie (10-50D): Height (cm)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
1	0.9	0.88	0.87	0.9	0.88	0.9	0.88
7	0.79	0.77	0.75	0.81	0.89	0.82	0.80
Cookie (10-52): Width (cm)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
8	9.3	9.35	9.35	9.15	9	8.95	8.85
8*	9.15	9.1	9.05	9.05	9	8.95	8.95
Cookie (10-54): Width (cm)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
9	8.32	8.04	8.4	8.31	7.93	7.81	8.35
Cookie (10-54): Height (cm)							
Lab	Ac Ariss	Ac Ron	Caledonia	Harus	25W60	D6234	D8006
9	0.87	0.95	0.77	0.89	0.88	0.96	0.79

* Milled with Brabender Quadrumat Jr. Mill.

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Section III

Methods

Methods

(Note: Laboratory numbers in parentheses are those of laboratories that provided specific procedures along with their analyses.)

Wheat Grain

Falling Number

AACC Method 56-81B (Lab 3, 4, 9)

Milling

Buhler milling was done with a Buhler MLU-202 Mill (AACC Method 26-31). Wheat was tempered to 14.5% moisture overnight. Extraction was calculated as flour/total products recovered; as is moisture basis. (Lab 9)

Milling with a Brabender Quadrumat Jr. Mill was done by Lab 8. After milling, sieving was done over 0.42mm and 0.16mm screens. Extraction was calculated as = 100 x [1 - (O_{v42}/wheat wt)]. Results are indicated with a *.

Moisture

Air oven (Lab 3, 4)

AACC Method 44-15A (Lab 6)

AACC Method 44-11 (Lab 9)

Protein

Reported on a 14% m.b.

NIR (Lab 3)

Dumas Combustion (Lab 4, 6)

AACC Method 46-13 (Lab 9)

Single Kernel Characterization Unit

(Lab 3, 4)

Softness Equivalent

Softness equivalent (SE) is correlated with break flour yield from a larger mill. SE = 100 x [(wheat wt - O_{v42}) – O_{v16}] / (wheat wt – O_{v42}). (Lab 8)

Test Weight

GAC 2100 (Lab 6)

AACC Method 55-10 (Lab 8, 9)

Whole Grain Total Dietary Fiber

AACC Method 32-07. Fiber was determined for the whole grain. (Lab 4)

Flour

Alkaline Water Retention Capacity

AACC Method 56-10 (Lab 4)

Alpha-Amylase Activity
Megazyme cereal alpha-amylase kit (Lab 4)

Amylograph
Campbell Soup Method: 60g flour, 450ml water. (Lab 1, 5, 7)
AACC Method 22-10 (Lab 4)

Ash
Reported on a 14% m.b.
AACC Method 08-01 (Lab 1, 5, 6)
AACC Method 08-02 (Lab 2, 7)
AACC Method 08-03 (Lab 9)
AOAC Method 923.03 (Lab 4)
Oven 2hr. ($MgNO_3$, 700°C) (Lab 3)

Brookfield Viscosity
Viscosity was determined on 167g of flour mixed with 250 ml of water. Mixing was done in a Hobart mixer for 5 minutes at speed 2 followed by resting for 4 minutes and mixing for 1 minute at speed 1. The reading was taken after 30 seconds with spindle #2. (Lab 7)

Damaged Starch
AACC Method 76-30A (Lab 8)
AACC Method 76-31: Megazyme kit (Lab 4, 9)

Falling Number
AACC Method 56-81B (Lab 4, 7, 9)
AOAC Method 976.13 (Lab 1)

Flour Particle Size
Malvern Mastersizer model X (Lab 8)

Gluten Index
AACC Method 38-12 (Lab 4)

Moisture
AACC Method 44-15A (Lab 1, 2, 4, 9)
AACC Method 44-16 (Lab 7, 8)
Brabender semi-automatic drying oven (Lab 5)

pH
AACC Method 02-52 (Lab 1, 7)

Protein
Reported on a 14% m.b.
AACC Method 16-12 (Lab 1)
AACC Method 46-11A (Lab 8)
AACC Method 46-30 (Lab 7, 9)
NIR (Lab 2)

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U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

EXHIBIT E
STATEMENT OF THE BASIS OF OWNERSHIP

Application is required in order to determine if a plant variety protection certificate is to be issued *(7 U.S.C. 2421)*. The information is held confidential until the certificate is issued *(7 U.S.C. 2426)*.

1. NAME OF APPLICANT(S)	2. TEMPORARY DESIGNATION OR EXPERIMENTAL NUMBER	3. VARIETY NAME
Michigan State University	D6234	MSU D6234
4. ADDRESS *(Street and No., or R.F.D. No., City, State, and ZIP, and Country)*	**5. TELEPHONE** *(Include area code)*	**6. FAX** *(Include area code)*
Michigan State University Office of Intellectual Property 246 Administration Building East Lansing, MI 48824-1046	(517) 355-2186	(517) 432-3880
	7. PVPO NUMBER	

8. Does the applicant own all rights to the variety? Mark an "X" in the appropriate block. **If no, please explain.** ☑ **YES** ☐ **NO**

9. Is the applicant (individual or company) a U.S. national or a U.S. based company? **If no, give name of country.** ☑ **YES** ☐ **NO**

10. Is the applicant the original owner? ☑ **YES** ☐ **NO** **If no, please answer one of the following:**

a. If the original rights to variety were owned by individual(s), is (are) the original owner(s) a U.S. National(s)?
☐ **YES** ☐ **NO** **If no, give name of country**

b. If the original rights to variety were owned by a company(ies), is (are) the original owner(s) a U.S. based company?
☐ **YES** ☐ **NO** **If no, give name of country**

11. Additional explanation on ownership *(Trace ownership from original breeder to current owner. Use the reverse for extra space if needed)*:

"MSU D6234" is an inbred line of common wheat selected from a cross made by the wheat breeder at Michigan State University. All selection and testing was conducted by Michigan State University personnel with Michigan State University resources. Michigan State University is therefore the originating breeder and owner of "MSU D6234." No other party has ownership rights to this line.

PLEASE NOTE:

Plant variety protection can only be afforded to the owners (not licensees) who meet the following criteria:

1. If the rights to the variety are owned by the original breeder, that person must be a U.S. national, national of a UPOV member country, or national of a country which affords similar protection to nationals of the U.S. for the same genus and species.
2. If the rights to the variety are owned by the company which employed the original breeder(s), the company must be U.S. based, owned by nationals of a UPOV member country, or owned by nationals of a country which affords similar protection to nationals of the U.S. for the same genus and species.
3. If the applicant is an owner who is not the original owner, both the original owner and the applicant must meet one of the above criteria.

The original breeder/owner may be the individual or company who directed the final breeding. See Section 41(a)(2) of the Plant Variety Protection Act for definitions.

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0581-0055. The time required to complete this information collection is estimated to average 0.1 hour per response, including the time for reviewing the instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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